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New species of fishes from the Malay Peninsula and Borneo

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We may regard the Malay Peninsula as the central station of the Indo-Pacific biological realm, and therefore a region extraordinarily rich in species of fishes. Nearly all the marine fishes found in the Red Sea and eastward through Polynesia either live along the shores of the Malay Peninsula and its islands, or pass through the Straits of Malacca or the South China Sea during their migrations.

Recent explorations in the region about Singapore have shown that many marine fishes, hitherto known only from a few specimens taken at far distant points in the Philippines or East Indies, have their real centre of distribution about the southern tip of Malaya. This statement is based on a study of the comparative abundance of certain species collected by me about Singapore and in various regions one to two thousand miles eastward and north-eastward from there.

The Malay Peninsula is likewise very rich in fresh water fishes, having very many species of Cyprinidæ, Labyrinth fishes, catfishes, and other strictly fresh water families. Most of those known from Sumatra and Borneo are known to occur in the streams of Malaya, and further exploration will undoubtedly reveal the presence of most of the remainder. The reasons for this similarity date from the time when Sunda Land included Malaya, Borneo, Sumatra, part of the Philippines, a considerable part of the present South China Sea, and other areas, and have been discussed by various authors, including myself. In addition, many of the fresh water fishes of Siam occur in the Malay Peninsula. Every bit of intensive collecting in the streams of central and northern Malaya brings to light more fishes hitherto known only from Siam. A very few fresh water fishes of Burma occur in the Malay States, and there is, of course, a number of fresh water fishes of general distribution from India to Malaya and the East Indies.

The new fishes here presented were collected in British North Borneo, Sarawak, and the Malay Peninsula from early in January to May 14th, 1937. In Borneo I had the invaluable co-operation of Mr. H. G. Keith, conservator of forests of British

North Borneo, and of Mr. E. Banks, curator of the museum at Kuching, Sarawak. The collaboration of Director F. N. Chasen, Curator M. W. F. Tweedie, Mr. De Fontaine, and other members of the staff of the Raffles Museum, enabled me to make large and important collections of fresh water fishes from the island of Singapore to Chenderoh Dam, Perak, and to secure many marine fishes not hitherto collected. Mr. Tweedie not only took me on many collecting trips by automobile, but made valuable collections himself. Director W. Birtwistle and his staff, of the department of fisheries, secured many marine and fresh water fishes not otherwise obtainable. A visit to Penang was made very profitable by the active co-operation and hospitality of Mr. M. R. Henderson, director of the Penang Botanic Garden. My heartiest thanks are hereby extended to all the gentlemen named; without their aid but little could have been accomplished.

In addition to the new species here presented, many rare or little known fishes were obtained, many of them hitherto unknown from the Malay Peninsula. In another paper will be presented these additions to the fish fauna of Malaya. The number of fishes already recorded from the Malay Peninsula is about 930; my tentative list includes about 1,000 species, after making allowance for errors and duplications in the published lists. I have no doubt that at least 1,500 marine and fresh water species occur in the seas and rivers of Malaya.

A vast amount of exploratory work remains to be done before we can have an adequate knowledge of Malay fishes, their distribution, breeding, and food habits. As an illustration of how little we actually know, a wealth of new or rare species was found by Mr. Tweedie and myself as a result of a couple of hours spent in working a brackish water mangrove flat on Singapore Island with water from two to six inches deep. Intensive collecting needs to be done in brackish water creeks and swamps, on coral reefs and rocky shores, in river mouths and estuaries, and in fact everywhere from Singapore to Kelantan and Perlis. Some of the common market fishes of inland towns in Perak, Trengganu, and Kelantan are not represented in collections.

The forest cover of the Malay Peninsula is being destroyed or altered at a tremendous rate. The jungle is destroyed and its place taken by rubber estates and pineapple plantations. With them goes the construction of automobile roads and the drainage of the roadside ditches and swampy areas that formerly swarmed with a fish fauna of amazing richness, variety, and beauty. Rills, brooks, and the few remaining water holes are sprayed with oil, so that they are uninhabitable for nearly all kinds of fishes. Every alteration in the natural ecological conditions upsets the whole balance of nature. The fishes of jungle streams and swamps are an integral part of the environment, and any

change in the natural cover of the land affects most of them unfavorably. Now and then some species is aided by new conditions and is able to multiply its numbers manyfold, but for most kinds the removal of the native forest means a great reduction in their numbers, or even their total destruction in the affected area. Every effort should be made to study the fishes of Malayan streams while there are still large areas of primitive jungle. It would be the part of wisdom to set aside wild life reserves in the lowlands, as well as in the mountains, so that future generations may see and enjoy the wealth of life, including fishes, characteristic of primitive Malayan forests at various altitudes. At the present rate of destruction a few more years will see the total elimination of lowland jungle, and the world will have lost a feature of extraordinary interest to every naturalist, artist, and lover of the outdoor world.

Homaloptera tweediei, new species. Plate I

Dorsal I–8; anal I–5 or 4; pectoral with 10 divided and 4 undivided rays; ventral II–7; scales in lateral line 36, plus one on the caudal base; 4 to 5 above the lateral line, 3 or 3.5 below to ventral base, and 5 below to median row beneath; 18–20 predorsal scales; 16 scales around caudal peduncle.

The depth is 6.6 to 6.8, the head 3.4 to 3.55, the caudal 3.5, the pectoral about 5, the ventral 5.75 to 6 times in the length. The eye is 3.8 to 4, the snout 2.6 times in the head; the interorbital equals the eye, which is a little more or less than 1.5 times in the snout; the least depth of the caudal peduncle is 2.1 to 2.2 times in its own length.

The body is slender, little elevated, the upper profile forming a gentle curve from the dorsal origin to the tip of the snout, the prominent eyes rising above the dorsal outline. The mouth is well arched, with thin lips, the barbels prominent. The maxillary barbel almost equals the eye, the outer rostral barbel nearly as long, the inner one smaller and much shorter.

The origin of the dorsal is opposite the sixteenth, the ventral origin opposite the fourteenth, the anal origin opposite the twenty-seventh scale of the lateral line; the dorsal origin is a little nearer the tip of the snout than the caudal base. The pectoral reaches beyond the ventral origin but the latter does not reach the anus, which is well forward of the anal origin. The lobes of the forked caudal are pointed. The head, and abdomen back to the ventrals, are naked.

In life the color is whitish with a brown stripe from the tip of the snout along the lateral line to the caudal base, 4 broad brown cross-bars over the back and down the sides, and a bar at the caudal base, the top of the head and snout blackish; the caudal and dorsal are more or less dusky.

In alcohol the cross-bands tend to disappear, and the back and sides are seen to be dotted with very minute brown specks; otherwise there is no change.

Described from the type and 3 paratypes, 23 to 26 mm. long. These and 4 other specimens were taken with a dip net from a shallow rapid creek in the Mawai district, Johore, about 40 miles north of Singapore. These little loaches lie on the sandy bottom under grasses and fixed algae growing in mid-stream. The 4 specimens not used in the description are in the collection of the Raffles Museum, Singapore.

Cobitophis perakensis, new species. Plate II

Dorsal I–6 or 5; anal I–5 or 6; pectoral I–6.

The depth is 14·3 to 15·75, the head 9·45 to 10, the caudal 10·9 to 11·5 times in the length. The eye is high up, in the anterior half of the head, 9·8 to 11 times in the head, 3 to 3·2 times in the snout, which is 3·3 to 3·4 times in the head. The postorbital is 1·6 to 1·7 times in the head. The fins are all very short, the pectoral 2·4 to 2·7, the ventral 2 to 2·75, the dorsal height 2 to 2·3, the anal height 1·85 to 2 times in the head.

The compressed, elongate body is eel-like, the ventrals, dorsal and anal placed far back. The anal origin is opposite the first divided ray of the dorsal; the dorsal ends opposite the second divided anal ray. The dorsal origin is above or just behind the vent. The preventral portion of the body is about 55·8% of the length, the ventral origin at the beginning of the third fifth of the body. The predorsal portion of the body is 75% of the length. The caudal is truncate or very slightly emarginate. The snout is bluntly rounded; three pairs of barbels, the anterior ones rostral, the third pair at the end of the maxillaries, the remaining pair half-way between the others, the longest barbels about twice the eye, 5 to 5·5 times in the head. The least depth of the elongate caudal peduncle is 4·1 to 4·2 times in its own length. The scales are very minute, scarcely visible with the aid of a compound microscope.

Specimens are brownish clay color, with minute dark brown punctulations over the back and sides; a dark band along the lateral line from near the head to the caudal, faint and narrow at first, broadest and darkest from the middle of the body to the caudal peduncle. The dorsal and caudal are cross-barred by rows of dark dots and in some specimens the anal is also thus marked.

Described from the type, 60 mm. long, and 4 paratypes, 45 to 54 mm. in length, collected from the lake above Chenderoh Dam, Perak. It lives on the bottom in foul places, under masses of water plants and rotting material.

From the closely related species it differs in the position of the dorsal, and in proportions.

Rasbora dorsimaculata, new species. Plate III

Dorsal II–7; anal III–5; pectoral I–14; the lateral line has 24 scales, plus 2 on the caudal base; 7 scales between the dorsal and ventral origins, 5 above and one below the lateral line; 10 predorsal scales, 7 between the lateral lines, over the caudal peduncle.

The depth is 4, the head approximately 3·3, the deeply forked caudal 2·95 times in the length. The large eye is 3 times, the snout 4·25 times, the flat interorbital 3·54 times in the head.

The mouth is strongly oblique, its anterior end as high as a line from the upper edge of the pupil, extending posteriorly to a line midway between the nostril and front margin of the eye. The dorsal and ventral origins are opposite a vertical passing over the hind margin of the 11th scale; from the tip of the snout to the dorsal origin is 51·78%, the distance from dorsal origin to caudal base 48·2% of the length. The dorsal height is 3·83, the pectoral length 4·66, the ventral 5·6, the anal height 6·22 times in the length. The ventrals almost reach the anal origin. The least height of the caudal peduncle is ·9 of its length to caudal base, or 1·5 in its length to the last row of scales on caudal base.

The color in alcohol is whitish yellow, each scale on the upper portion covered wholly or in part by a dark brown spot, the top of the head nearly black; a black line extends along the side from the opercular angle to the caudal base, indistinct anteriorly but distinct on the posterior half. The fins are all clear except the dorsal, which a large has black spot at the top of the first 3 rays.

The type and only specimen, 28 mm. long, was taken from a brook 16 miles east of Kuching, Sarawak, Borneo.

Key to Lissochilus species of Malaya

A. Dorsal spine strongly toothed behind
  B. 14 scales around caudal peduncle; l.l.28–31, plus 1–3 on caudal base; predorsal scales 10–12; pectoral equals head; V. a little shorter. *L. normani*
  BB. 12 scales around caudal peduncle; l.l.27–28; predorsal 8 (very rarely more); pectoral and V. 1·25 in head. *L. smedleyi*

AA. Dorsal spine smooth behind; 12 scales around caudal peduncle.
  C. Lateral line 21 plus 2 (rarely 20 or 22); predorsal scales 5–6. *L. hendersoni*
  CC. Lateral line 23 or more.
    D. l.l.24–25; predorsal 8; transverse 3·5 above and 3·5 below. *L. tweediei*
    DD. l. l. 26–29; predorsal 8–9; transverse 3·5 above, 4·5 below. *L. dukai*

L. Dukai is included because Weber and De Beaufort give it as in the Malay Peninsula but I do not believe it occurs in our territory. Apparently *L. tweediei* replaces *L. sumatranus* in Malaya. *L. smedleyi, normani,* and *hendersoni* are all very different from *L. dukai,* which has a weak dorsal spine.

Lissochilus hendersoni, new species. Plate IV

Dorsal IV–9; anal III–5; pectoral I–13; scales in the lateral line 20—22+2, mostly 21; from lateral line to dorsal origin 3·5, and to ventral 2; from lateral line to median line, 3·5; predorsal scales 6, rarely 5; scales around caudal peduncle, 12.

The plump body is moderately compressed, its dorsal profile well elevated and forming an angular arc, the ventral profile broadly curved, the belly wide and more or less protuberant, the caudal peduncle slender. From the dorsal origin to the top of the snout the profile is decidely convex.

The depth is 3·3 to 3·5 times, the head 3·1 to 3·6 times, the caudal about 3 times in the length. The eye is 3·2 to 3·6 times in the head, 1·6 to 1·8 times in the postorbital; the blunt prominent snout is 3·35 to 3·5 times in the head, a little longer than the eye; the interorbital exceeds the eye, 3 to 3·6, the postorbital 2·1 to 2·4 times in the head. The dorsal origin is opposite the sixth scale of the lateral line, much nearer the tip of the snout than the caudal. The dorsal is emarginate, its height 4 to 4·2 times in the length. The ventral equals the height of the anal, 5·3 to 5·5 times, the pectoral 4·5 to 4·7 times in the length. The least depth of the caudal peduncle is 1·3 times in its own length. An axillary ventral scale is about four-fifths of the eye. The barbels are usually of equal length but sometimes the maxillary barbel is a little the longer, their length approximately equal to the eye. Several minute lines of sensory pores radiate downward from the lower margin of the eye. On the preorbital and suborbital are numerous small horny tubercles, arranged in 3 or 4 irregular rows, and covering pores.

The color of preserved specimens is pale yellowish or tan, the top of the head and nape dusky brown, each scale above the belly with a vertical dark brown bar at its base.

Here described from the type, 70 mm. long, and 27 paratypes 59 to 67 mm. long, taken from a fresh-water creek on Penang Island.

I take pleasure in dedicating this species to Mr. M. R. Henderson, director of the Penang Botanical Garden through whose hospitality and co-operation I was enabled to collect the fresh-water fishes of the beautiful isle of Penang.

Puntius kuchingensis, new species. Plate V

Dorsal IV-8; anal III-5; pectoral I-14; ventral I-7; lateral line 20–21 plus 2; transverse scales $\frac{4\cdot5}{1}$; predorsal scales 7; scales around caudal peduncle 12.

The strongly compressed oblong body has a well arched ventral outline; the dorsal profile is slightly concave above the nape, then is markedly convex with a sharp ridge before the dorsal. The depth is 2·3 to 2·45, the caudal 3·2, the head 3·4 to 3·5 times in the length. The eye is slightly less than or equals the snout, 3·8 in the head and 1·5 times in the interorbital. The oblique mouth is strongly arched, the lower jaw slightly inferior, the maxillary reaching or nearly reaching a vertical from the front edge of the eye. The rostral barbel is slightly longer than the eye, the maxillary barbel 1·7 times the eye and almost reaching the gill opening. The origin of the dorsal is opposite the eighth scale of the lateral line, the ventral origin opposite the ninth scale. The dorsal is slightly concave, the third spine rather finely denticulate behind, the bony portion equal to the length of the pectorals and ventrals, 1·35 in the head; dorsal with a rather high basal sheath; origin of ventral separated by 2 or 2·5 scales from the lateral line, its tip reaching the anus, the caudal deeply incised with round-pointed lobes. The least height of the caudal peduncle more or less equals its own length, about 1·9 in the head. Scales with more or less parallel longitudinal lines.

The color in alcohol is brownish red, with two black cross-bands; the first descends obliquely from behind the head to the pectoral, the second from before the dorsal to above the ventral, both bars more or less windened in the upper part; each scale of the lateral line with a black circular spot; a black spot also more or less evident on each scale of the three rows above the lateral line; and posteriorly on the line below; a small circular spot above the anal origin; the anal tip is black, the fins otherwise clear.

Described from the type, 67 mm. long, a paratype 44 mm. long, and a damaged paratype, 65 mm. long, with missing caudal, obtained 18 miles east of Kuching, Sarawak, Borneo.

Parakysis Herre, new genus.

This genus is unlike *Akysis* as it lacks an adipose dorsal fin. Its short broad head and rather stout short body are markedly different from those of *Breitensteinia.* The skin is covered everywhere with very small granules or tubercles. A narrow median longitudinal fontanelle, divided by a bony cross bar, extends on the top of the head from the snout to the basal bone of the dorsal spine. The anterior nostril is tubular; the posterior nostril has a rim from the anterior part of which extends a slender barbel longer than the head. The longer slender maxillary barbels are at the angle of the mouth; the long slender

mandibular and mental barbels are below the mouth; the mandibular barbels each have a small accessory basal barbel, while the mental barbels each have two or three accessory basal barbels. The short dorsal has a stout spine covered by thick skin, and 4 soft rays; its hind end is inserted well in advance of the ventral origin; ventrals 6-rayed, extending to the anal, or not. The pectorals have a stout smooth bony spine covered with thick skin. The caudal is deeply emarginate. The small, upward-looking eyes are covered with skin. The mouth is small, with protruding upper lip; jaws with villiform teeth, none on the palate.

The gill opening extends above the pectoral base a short distance. The isthmus is very wide.

The type is *Parakysis verrucosa* Herre, new species, known only from the streams of Johore and Sarawak.

Parakysis verrucosa, new species. Plate VI

Dorsal I–4 or 3; anal I–7 or 8; pectoral I–6.

In the type specimen, 31 mm. long, or 40 mm. including the caudal fin, the depth is 5, the head 4·6 the caudal 3·44 times in the length. The very small eye is 13·4 times in the head, 4·4 times in the snout, 5 times in the interorbital, and 8 times in the postorbital portion of the head. The interorbital is 2·68 times, the snout 3, the postorbital 1·675 times in the head. The least depth of the caudal peduncle equals its depth.

The breadth of the head is a little more than its length, the snout broadly rounded. The mouth is small, much like that usually seen in the *Callionymidae*, the upper lip protruding in a rounded flap. In the type the nasal barbels are only as long as the head, but in the other specimens they extend back nearly to the dorsal, as far as or farther than the maxillary barbels. The mandibulary and mental barbels extend to the posterior end of the head or to the pectoral base, or the mandibulary barbels may extend beyond the pectoral base. Each mandibulary barbel has a short accessory basal barbule, and each mental barbel has two or three such barbules. The dorsal and pectoral spines are smooth. The ventrals are twice the height of the dorsal, and much more than the anal height. Some specimens, especially those from Borneo, have a low ridge or keel on the dorsal side of the caudal peduncle. The caudal is deeply emarginate, the lobes with pointed tips.

In other specimens, from 22 to 29 mm. standard length, the depth varied from 4·6 to 5·1 times in the length, but was very close to 5 in almost all specimens. There is little variation in the other measurements.

The color in alcohol is dark brown, very pale yellowish beneath, the sides mottled with very pale spots like the color of the belly. The basal two-thirds of the dorsal is dusky brown, the

rest clear; the other fins are all more or less transversely barred with brown dots. Many of the granules on the back and sides are black.

Here described from the type, 31 mm. long, and 10 paratypes, 22 to 29 mm. long, from the Mawai District, Johore, and 3 specimens, 20 to 26 mm. in length, taken from a small brook 18 miles east of Kuching, Sarawak, Borneo. The dermal warts or tubercles are much less developed in the Borneo specimens than in those from Johore.

Verrucosa, covered with verrucæ, or warts.

Mystus johorensis, new species. Plate VII, VIII

Branchiostegals 12; dorsal I–7; anal III–8; pectoral I–9.

The oblong, robust body is but little elevated, the dorsal profile of the flattened head descending in a straight line to the rounded snout which projects beyond the mouth; the depth is 4·95, the head 3·1, the caudal 3·5 times in the length. The depth of the head is seven-ninths of its breadth, the latter 1·5 in the length of the head. The eye is 6·7 times in the head, 2·5 in the snout, which is 2·68 in the head, the postorbital a trifle less than half the head. The top of the head is covered with skin, beneath which a few rugae are poorly visible; a median narrow groove runs from opposite the posterior nostril to the occipital process; it contains 2 fontanels separated by a bone bridge; the first is a little before the eyes; the second begins opposite the middle of the eyes and is about an eye diameter in length. The elongate, nearly linear occipital process reaches almost to the basal dorsal bone, and except at its origin is deeply buried in the thick, fleshy, convex nape; only dissection reveals its presence.

The nasal barbels extend four-fifths of the distance to the eye, and are a trifle longer than the eye. The maxillary barbel reaches to the posterior end of the dorsal base, the mandibulary barbel to the axil of the pectoral; the mental barbel does not reach a vertical from the hind margin of the eye.

The weak dorsal spine is a little longer than the snout, 2·48 times, the longest ray 1·57 in the head; the stout pectoral spine is strongly serrated posteriorly, 1·46 in the head; the dorsal base and adipose fin are approximately equal, about 2·2 in the head, the space between them equal to the snout. The anal base is about thrice in the head; the ventrals equal the adipose fin. The caudal is deeply forked, the upper lobe a little the longer. The villiform teeth are in bands, those of the lower jaw crescentic, those of the palate strongly so, all the bands about the same width. The least depth of the caudal peduncle is 1·55 times in its own length, 3·7 in the head.

The color in alcohol is very deep brown, to blackish brown, the under side of the head and belly whitish yellow, the fins all deep brown to black, the pectorals and ventrals yellow basally.

Described from the type and sole specimen, 208 mm. long, taken from Sungai Kayu, 16 miles north of Kota Tinggi, Johore.

Mystus pahangensis, new species. Plate IX

Branchiostegals 9; dorsal II–6; anal II–8; pectoral I–8.

The dorsal profile of the oblong body descends in a strongly sloping straight line from before the dorsal to the rounded snout; behind the dorsal the profile is a very gentle arc to the caudal peduncle. The depth is 5·16, the head 3·25, the caudal 3·16 times in the length. The head is broader than high, its breadth 1·6, its depth 2·14 times in its own length. The top of the head is covered with skin, beneath which corrugations can be seen. A narrow fontanel extends back two thirds of the distance from the snout tip to the base of the narrow, short occipital process, which is separated from the basal process of the dorsal spine by a wide interspace; the thick nape is convex. The eye is 6·66 times in the head, 2·44 in the snout, which is 2·7 times in the head. The nasal barbels almost reach the eye, the maxillary extend to the anal origin, the mandibulary barbels reach to the pectoral base, and the mental fall much short of the gill opening.

The short weak dorsal spine is scarcely serrulate behind, its bony part 2·6 times, its total length twice in the head; the adipose fin is of moderate length, equal to the dorsal base, nearly twice in the head (1·94) the space between the dorsal and adipose fins 2·4 times in the head. The anal base is much shorter than the adipose fin, more than 2·7 in the head. The flattened pectoral spine is of moderate size, with a very few teeth behind its tip, 1·76 in the head, nearly 1·5 times the dorsal spine. The ventrals equal the postorbital, 2·1 in the head. The caudal is deeply forked, the upper lobe with a filiform tip. The villiform teeth are in bands, those on the palate and lower jaw crescent-shaped; the palatal band is narrower in front, but broader posteriorly than the maxillary band. The caudal peduncle is 1.37 times in its own length, 3·75 in the head.

The color in alcohol is uniform dull dusky, the under side of the head and belly white. The dorsal is clear, somewhat clouded with dusky, the adipose fin reddish brown, the other fins clear but the caudal tinged with brown.

Described from the type, 196 mm. long, from the Sungai Garam, near Karak, Pahang.

Neostethus borneensis, new species. Plate X, XI

Dorsal II (sometimes I ?) I–4; anal II–13 or 12; pectoral I–8; scales in a lateral series 26 or 25 plus one on the caudal base in males, and 26 to 27 plus one in females; predorsal scales 15 or 16, sometimes 18 in females; preopercle with 3 large scales; transverse scales from second dorsal origin to that of anal, 8 or 7·5; vertebrae 14 plus 18.

The first dorsal is 2 scales before the second dorsal and is over the base of the 12th or 13th anal ray in males; in females it is over the base of the last ray or behind the anal.

The depth is 5·8 in the length in a male 21·5 mm. long, and 5·25 times in a female 24·5 mm. long. In mature males 12 to 18 mm. long the depth is 4 to 4·35, the head 4·4 to 4·9 times in the length. The eye is 2·65 to 2·75 times in the head, the snout 1·85 to 2 times in the eye. The pectoral is 1·2 in the head, 5·8 in the length; the caudal is 2·8 to 2·9 in the length; the anal height is 1·33 in the head, 6·75 to 7 in the length; the second dorsal is lower, 1·5 to 1·8 in the head, 8 to 8·75 in the length; the least depth of the caudal peduncle is 1·6 to 1·75 times in its own length in specimens 13 to 17 mm. long, but in one of 21·5 mm. the depth is 2·5 in its length.

In females 13 to 16 mm. long the depth is 3·75 to 4·3 times in the length, and 5·25 in a female of 24·5 mm. The head is 3·9 to 4·4 in the length. The eye is 3 times in the head, the snout 1·6 to 1·8 in the eye. The pectoral is 4·66 to nearly 6 times in the length, usually about 5; the caudal is 2·3 to 3 times in the length; the anal height is 6 to 7, the second dorsal 7 to 8 times in the length; the least depth of the caudal peduncle is 2 to 2·5 times in its own length.

The dorsal profile of the greatly compressed body is nearly horizontal, the ventral profile moderately arched. The mouth is nearly vertical, with projecting chin, its angle beneath the anterior part of the eye; the teeth are relatively large and strong, curved, and apparently in one row in both jaws. The pectoral is elongate, pointed; the lobes of the forked caudal have very elongate, filamentous tips; all the fins are very delicate and easily broken. As in all Phallostethids, there is a membraneous keel along the belly.

Sexually mature, or nearly mature males are from 12 to 21·5 mm. long, nearly all my specimens between 14 and 17 mm. Immature males are from 11 to 16 mm. One of 11 mm. had the priapium well advanced in development, while in others of 16 mm. the priapium had not started to develop.

The priapium is attached to the left or right of the median line and is folded toward the other side; it is fully extended only when the ctenactinium is used to grasp the female during fertilization. The curved slender ctenactinium springs from the latero-posterior part of the priapium, its anterior portion lying in a groove behind the chin and continuing onward and upward; sometimes the tip of the ctenactinium perforates the tissue below the groove. On the inner side behind the ctenactinium base is a slender, curved, pointed bone, the "priapklaue" of Aurich, like a second ctenactinium; on its outer side a short distance removed is a fleshy tube, the penis; frequently the penis is not yet

developed, and often it is represented by the very slender, very fine-pointed bone that supports it internally; when fully developed it is comparatively thick and fleshy, and as long as the "priapklaue." Neither of the two structures can be seen unless the ctenactinium is lifted far back so as to extend the priapium completely. The pulvinulus is elongate, ovoid, cartilaginous and slightly concave, its margin free, the tip caudad; it is attached by a short thick pedicel to the anterior part of the priapium, on its aproctal side.

Female specimens are more convex ventrally than males, and of course lack the priapium; the genital opening is rather far behind the anus, the rounded abdomen without a groove.

In some of the smallest specimens what appear to be vestigial ventrals are present. A thickened ring forms about the anus anteriorly and laterally, then gradually enlarges till it is encircled. Soon the thick ring divides posteriorly, its free ends lengthening until vestigial rays are present.

In life two tiny spots with a pale golden sheen, the eyes, are all that is visible of these very slender little fish. Occasionally when one turns on its side a similar minute spot is visible, the peritoneum having the same lustre.

When placed in alcohol or formalin the eyes become black and the body whitish. A row of black dashes forms a line from the upper angle of the opercle to the middle of the caudal base; the scales above it are more or less distinctly bordered by dark brown dots and a row of small spots extends along the median dorsal line; a black line on the under side of the caudal peduncle extends forward on either side of the anal base; dark specks are more or less abundant underneath and on the sides of the head and pectoral base; fins colorless.

These fish swim at or very near the surface of salt, brackish, or fresh water in groups of a very few up to schools of several score. My first specimens were taken by accident while catching cyprinids with a dip net. Close watch for a couple of days enabled me to recognize their presence, which had never been observed by the Dyaks. They are to be found in tidal streams, in swamp pools, in estuaries and bays of salt water, and in fresh water brooks. In streams they swim along the shore, thus avoiding strong currents when going up stream. When disturbed they dive to the bottom and hide for a time.

In mangrove swamps which are fresh water or very slightly saline at low water, they occur in vast numbers, most of them being immature. In such places it is practically impossible to catch them. The water is from an inch to several inches in depth and is filled with erect, finger-like aerial mangrove roots as well as large lateral roots and all the litter of a dense tropical forest. Such an environment affords a maximum of protection

and hiding places to these tiny transparent fish. On my last day, as we were going down the river, I discovered that an almost continuous school of mature fish was along the shore, swimming up stream with the flood tide. Had this been found out before, very many larger and more mature specimens could have been secured. As it was, we had to keep our boat away from shore to avoid being grounded and forced to spend the night without protection in the jungle.

From a brook flowing into the Kabili River, British North Borneo, and a nearby swamp I collected 60 males from 12 to 21·5 mm. long, all mature or with the ctenactinium in an advanced stage, and 55 from 11 to 16 mm. long without a priapium, or the ctenactinium only embryonic.

One female specimen of 24·5 mm. and 30 others from 13 to 16 mm. were taken at the same time. 9 other specimens of 11 to 12 mm. and undetermined sex have more or less evident vestigial ventral fins.

From the Segaliud River, British North Borneo, I took a mature male 16 mm. long, a female of 12 mm., and 7 others from 10 to 15 mm. in length, including one of 11 mm. with ventral fins.

This fish is abundant in sheltered inter-island canals and inlets of Sandakan Bay, as well as in all its tributaries and adjacent swamps, up to where the water is fresh part or all of the time.

The discovery of this species fulfills the prediction of Dr. George S. Myers, who stated several years ago that Phallostethids must occur in Borneo. No doubt further exploration will reveal additional species of the family in Bornean waters.

Vaimosa avicennia, new species. Plate XII

Dorsal VI–I–7; anal I–7; there are 27 scales in a longitudinal series, plus 2 on the caudal base, and 8 from the second dorsal origin to the anal origin; predorsal scales, 6; opercular scales, 6.

This tiny goby has teeth unlike those of any other member of the genus thus far described. In addition to 2 or 3 rows of very minute teeth as usual in this genus, the lower jaw has a pair of large caniniform symphysial teeth, with enlarged bases, and a similar tooth at each outer angle of the jaw. The upper jaw has an outer row of widely spaced and very small teeth, behind which are rows of microscopic teeth.

The elongate slender body has the upper and lower profiles nearly horizontal and parallel, the depth 5·45 times in length. The broadly rounded caudal equals the head, 3·33 times in the length. The large, dorso-lateral eyes are high up, 4·5 in the head, 2·5 times in the postorbital; the broad, blunt, nearly vertical snout equals the eye; the interorbital is twice in the eye;

the head is very broad, its width 1·4 times, its depth 1·8 times in the head. The first dorsal is damaged, the first spine 2·25 times in the head, the dorsals far apart; the last ray of the second dorsal is longest, extending to the caudal base, 1·28 times in the head; the penultimate anal ray is longest, 1·6 times in the head; the pectoral is 1·5 times, the broad ventrals twice in the head; the wide caudal peduncle is 1·75 times in its own length.

The color in alcohol is brownish gray, the scales everywhere except behind and under the ventrals punctulated with minute specks; there are traces of 5 dusky cross bands over the back, and down the side, where they alternate with 4 dark bars along the mid-line; the head is mottled with dusky, with a blackish band running diagonally from the eye across the opercle. The dorsals, anal, and caudal are black, the second dorsal with a white marginal band, the caudal with a wide white band along the top and rear, both bands with a marginal black line.

The type and only specimen, a male 30 mm. long, was caught in a mangrove swamp drained by the Kranji river, Singapore.

Avicennia, the name of a genus of mangroves.

Vaimosa jurongensis, new species. Plate XIII

Dorsal VI–I–6 or 7; anal I–6; scales in longitudinal series 24 or 25+1 on caudal base; predorsal scales usually 6, sometimes 7, in one specimen 5; scales in transverse series from second dorsal origin to anal origin, 7; four or five large scales on the opercle.

This is a big-headed, stoutly built fish, laterally compressed posteriorly and therefore wedge-shaped seen from above. The depth is 4 to 4·5 times, the head 2·9 to 3 times, the broadly rounded caudal 3·3 to 3·5 times in the length. The breadth of the head equals or exceeds the body depth, 1·35 to 1·4 times in the length of the head, or 4 to 4·1 times in the standard length. The eye is 5 to 5·4 times in the head and 1·3 to 1·5 times in the snout, which is 3·5 to 3·9 times in the head. The postorbital is 1·8 times, the interorbital 5·4 to 5·8 times in the head.

The body is deepest before the first dorsal, descending rapidly to the interorbital, the snout convex and broadly rounded. The mouth is large to very large; in the smallest specimens the maxillary extends to beneath the middle of the eye, and in mature ones it reaches much beyond the eye and is 1·6 to 1·7 times in the head; most of the specimens seem to be males, but the mouth extends at least to the hind margin of the eye in mature females.

The minute teeth are in 2 or 3 rows anteriorly, but reduced to a single row posteriorly. The first dorsal is low, seldom reaching the second dorsal origin when depressed, the third spine 2·2 to 2·5 in the head; the second dorsal and anal do not reach

the caudal when depressed, the penultimate ray longest, 1·9 to 2 times in the head. The large, rather pointed pectoral extends to the origin of the anal or a little more, its length 3·25 to 3·5 in the standard length. The large ventrals extend beyond the vent and may reach the anal, 4 to 4·3 times in the length. The opercular scales are deeply embedded and very hard to see. The anal papilla is very small, the sexes not well differentiated as none are in breeding condition.

In life this little fish is a pinkish red, almost flesh color, with a red spot on each scale on the upper half of the body, the caudal and dorsal fins with cross rows of red spots.

In alcohol the color is pale whitish yellow, with 5 or 6 broad blackish cross bands over the back; 4 narrow dusky bars along the side, the first beneath the pectoral tip, the last on the caudal base, where it merges into a vertical black bar; beneath the pectoral is a vertical black stripe or spot; a brown or blackish bar extends from the eye diagonally backward upon the preopercle; the opercle is more or less black spotted; the first dorsal has a clear band across its middle, with a row of black spots above and below it, the lower one ending in a large black spot; the second dorsal has 3 or 4 cross rows of black spots; the caudal is cross barred by 5 or 6 rows of black spots; the other fins are clear; the eyes are green.

Here described from the type, a male 35 mm. long, and 24 paratypes, mostly males, 19 to 34·5 mm. long, taken from a brook at Jurong, Singapore Island, May 8, 1937. A unique species, unlike any other *Vaimosa* thus far described.

Vaimosa kabilia, new species. Plate XIV

Dorsal VI–I–7; anal I–7; scales in lateral series 27, plus 2 on caudal base; transverse series 8, predorsal 11–12; opercular scales, 8.

The type, a gravid female 36 mm. long, has the depth 4·66 times, the head 3·25, the caudal 3·6, the pectoral 4, and the ventral 6 times in the length. The eye is 4·8 times, the snout 4 times in the head. The interorbital is 1·25 times in the eye.

The body is robust, the dorsal profile nearly horizontal, the ventral profile slightly arched, the last half of the body laterally compressed; the head is broad, its width 1·37 in its own length, its depth 1·8 times. The blunt snout is convex; the wide, slightly oblique mouth reaches a vertical slightly beyond the middle of the eye; the teeth are minute, typical; the interorbital is wide and flat; the dorso-lateral eyes are in the anterior half of the head and project above the dorsal profile. There are 2 curved rows of sensory papillæ across the cheek.

The fins are all short; the dorsals are far apart, the first not reaching the second by 3 scales when depressed; the second dorsal and anal when depressed are distant from the caudal; the

first dorsal height is 2·75, the second dorsal and anal 2·2 times in the head; the pectoral is broad, the ventrals noticeably short, remote from the anus; the caudal is short and bluntly rounded; the least depth of the caudal peduncle is twice in its own length.

The color in alcohol is whitish, each scale except on the belly with a vertical blackish bar under its middle; above and behind the pectoral base is a diagonal black bar; a blackish brown stripe runs from the lower margin of the eye back upon the pectoral base, becoming a diffuse blotch on the opercle; two dusky stripes from the eye to the margin of the snout. The dorsals are marked by cross rows of black dots; the caudal has two large black spots on its base, and numerous cross-rows of black dots on its upper three-fourths; the other fins are tinged with pale brown, the anal with a dark margin.

A female paratype, 31 mm. long and not in breeding condition, offers no essential differences; of course it is slenderer, its depth 5.16, and the vertical fins are proportionally a little longer. It also agrees with the type in coloration.

Two specimens, from the Kabili river, British North Borneo. A handsome, well-marked species.

Vaimosa oratai, new species. Plate XV

Dorsal VI–I–7; anal I–7; there are 23 scales in a lateral series, 7 scales from the dorsal origin to the anal origin, 6 predorsal, and 5 scales on the opercle.

The depth is 4 times, the head about 3, the caudal 3·4 to 3·6 times in the length. The eye is 3·5, the snout 4·6 to 4·9, the postorbital twice in the head; the protuberant dorso-lateral eyes are very close together, the interorbital less than a third of an eye diameter.

The body is oblong, the upper profile very gently convex, the bluntly rounded snout descending obliquely, the lips even; the mouth extends to beneath the front part of the eye in the female, to beneath the hind margin of the eye in the male. In a male specimen the first dorsal spine is excessively long and filamentous, reaching beyond the posterior end of the second dorsal base, 2·24 times in the length; in a female the first dorsal is low, the second spine longest, 2·4 times in the head, or 7·2 in the length. The second dorsal and anal are of equal height, and fall much short of the caudal when depressed, twice in the head, 6 times in the length. The pectoral is 1·7 in the head; the broad ventral reaches the anal papilla, 1·3 in the head, the least depth of the caudal peduncle is 2·14 in its own length; the anal papilla is thick and broadly rounded in the female, more pointed, much thinner and smaller in the male.

The color in alcohol is yellowish to grayish white, with 5 broad cross bands, composed of blackish brown dots, over the back, and 5 short dark bars alternating with them along the

middle of the side; a dusky cross bar on the caudal base in the female, a dark brown patch enclosing a white spot on the caudal base of the male; 3 or 4 black spots on the median line under the anal and caudal peduncle; the female has a short blackish brown band from the eye down and back across the preopercle, and a blackish brown spot covering most of the opercle. The dorsal has a large black spot posteriorly and a similar cross band on the upper third; the second dorsal has a basal and a marginal blackish longitudinal band; the pectoral is clear, the other fins more or less specked.

Described from the type, a gravid female 18 mm. long, and paratype, a male 13 mm. long, taken from a brook at Tawau, British North Borneo.

Named for Captain Orata, head of the Borneo Fishing Company, at Tawau, whose hospitality was a great help during my stay at Tawau.

Vaimosa perakensis, new species. Plate XVI

Dorsal VI–I–6; anal I–6 or 5; there are 24 or 25 scales in lateral series, plus 1 or 2 on the caudal base, 7 in transverse series from second dorsal origin to anal origin, 24 or 23 scales from the pectoral base to caudal base; predorsal scales 6 or 7; five scales on opercle, deeply imbedded and difficult to see.

The head is 3 to 3·2 times, the depth 4·7 to 5, the caudal 3·8 to 4, the pectoral 3·6 to 4·1 times in the length. The eyes are very high up, projecting above the dorsal profile, in the anterior half of the head, about 4 times, up to 4·5 times in the head; the broadly rounded snout equals or is less than the eye, usually 4·5, rarely 4·1 times in the head; the eyes are close together, the interorbital 2·85 times in an eye diameter. The oblique mouth is large, becoming very large in mature males; even in the youngest it reaches a vertical from the eye; in females it extends to a vertical from the middle of the eye or the posterior rim, and may exceed the eye; in adult males it always extends beyond the eye, the maxillary 1·6 to 1·8 times in the head.

The body is rather slender and elongate, the head broader than deep, its width 1·3 to 1·4 in its length; the first dorsal is low, but in adult males the first spine may become elongate with a filamentous tip reaching well over the second dorsal, then 1·4 to 1·6 times in the head; the second dorsal is 1·6 to 2 times, the anal 1·8 to 2·3 times in the head. The rounded pectoral is 1.1 to 1.35, the ventral 1·4 to 1·6, the caudal 1·2 to 1·3 times in the head. The least height of the caudal peduncle is 1·9 to 2 times in its length.

The color in life is pale yellowish golden, with 4 or 5 dusky cross bands over the back, 3 narrow elongate dusky bars along the middle of the side, and a black bar at the caudal base; the dorsals and caudal with transverse lines of dusky spots.

Preserved specimens are whitish, with 5 more or less evident dorsal cross bands, and 3 longitudinal bars along the side, the first below the interdorsal space; a fourth bar merges with a vertical bar on the caudal base; the scales on back and sides are margined with dark brown dots; a short dusky diagonal bar from the eye on the preopercle and a large dark spot on the opercle; the dorsals are cross-barred by 2 rows of black dots, the caudal by 4 to 7 rows; a black spot at the rear end of the first dorsal base and 2 black dots under the second dorsal; the pectoral is clear, the ventral and anal clear to dusky.

Described from the type, a male 25 mm. long, and 143 paratypes, 8 to 26 mm. in length, from the lake above Chenderoh Dam, and 16 paratypes 12 to 28 mm. long, from a brook 2 miles north of Sauk, all in Perak. Females are mature when 19 mm. long; the largest egg-bearing female is 25 mm. long. All were taken in March, 1937.

This interesting little species seems to be nearest *Vaimosa siamensis* Fowler from which however it differs in several respects. It affords a fine illustration of the way in which man, the destroyer, sometimes unwittingly gives an animal an opportunity to increase its numbers prodigiously. In the swift hill streams that are the natural habitat of this goby there are few places where it can live, as it demands quiet shallow water, rich in plankton. When Chenderoh Dam was built, a lake 15 miles long and half a mile to a mile and a half wide was created. Along its banks, around the submerged trees and stumps, in grass grown bays, and shallow inlets where the bottom is covered with decaying leaves, are found ideal conditions for this species, so that it now occurs there in great numbers.

Ctenogobius kranjiensis, new species. Plate XVII

Dorsal VI–I–10; anal I–9; scales in longitudinal series 26, plus 2 on the caudal base, 7 in transverse series; predorsal 6 or 7. One specimen has 9 rays in the second dorsal, 8 in the anal.

The depth is 4·8 to 5, the head 3·6 to 3·8, the caudal 3 to 3·5, the pectoral 4·5 times in the length. The eye is 3·8 to 3·9, the snout 4 to 4·25 times in the head. The least depth of the caudal peduncle is 1·7 times in its own length.

The fusiform body is deepest at the ventral origin, the broad blunt head as wide as or wider than the depth, the short broad snout boldly convex. The mouth is oblique, the maxillary extending to a vertical from the front margin of the pupil. The minute teeth are in 3 rows in each jaw, an outer row of larger teeth, with two rows of excessively fine teeth; no canines. From the eye 6 rows of sensory papillæ extend downward on the cheek; these are crossed by 2 longitudinal rows, the lower one from the

angle of the mouth to the lower end of the sixth vertical row; there is also a vertical row of papillæ on the opercle; the predorsal scales do not extend to the eyes.

The fins are all low, the first dorsal in males usually reaching the origin of the second dorsal when depressed; the height of the first dorsal is 2·66 times, the last ray of the second dorsal and anal twice in the head. The second dorsal and anal do not reach the caudal by 2 or 3 scales; the caudal is elongate and rather pointed; the short ventral does not reach the anus, 1·6 times in the head.

The color in alcohol is very pale yellowish, with 5 brown spots along the middle of the side, the first under the first dorsal, the second and third under the second dorsal, the fourth on the caudal peduncle and the last on the caudal base; the dorsal portion of the body is marked or mottled by brown spots; a circular brown spot on the middle of the cheek and a spot on the upper part of the pectoral base; a dark bar from the eye across the snout; the opercle is marked with brown. The first dorsal has an elongate black spot between the fifth and sixth spines, or males may have the fin largely dark brown or black; the second dorsal and anal are dusky, the latter with a clear margin; the caudal is light brown, with 2 black spots on its upper margin, near the base; the other fins are colorless. The eyes are more or less green.

Described from the type, a gravid female 29 mm. long, and 13 paratypes, 23 to 29 mm. in length. Several other females are also nearly ready to spawn. The males are smaller than the females. This little goby was collected from a small stream, the Kranji, draining a mangrove swamp on the north side of Singapore Island.

Ctenogobius paludosus, new species. Plate XVIII

Dorsal VI–I–8; anal I–7; there are 26 scales in a lateral series, plus 2 on the caudal base, 7 in transverse series; 6 predorsal scales.

The depth is 5·45, the pointed caudal 3·33, the head 3 times in the length; the depth of the head is nearly twice in its length, its breadth 1·4 times; the eye is 5·2, the snout 3·9, the postorbital 1·8 times in the head; the interorbital is 1·9 times in the eye. The dorsal and ventral profiles are nearly parallel, the head broad, with blunt, little rounded, gently sloping snout; the oblique mouth is very large, the maxillary extending beyond the eye nearly to the angle of the preopercle, almost exactly twice (1·98) in the head; the teeth are minute, in 3 rows above and 4 below, with a very small canine at the anterior angle of the lower jaw; the dorso-lateral eyes are in the anterior half of the head.

The vertical fins are low, the first dorsal falling much short of the second dorsal when depressed, 2·8 times in the head; the

second dorsal and anal are of equal height, 2·25 in the head, their tips far from the caudal when depressed; the pectoral is 4, the ventral 4·3 times in the length; the anal papilla is thin, small, round pointed; the least depth of the caudal peduncle is twice in its own length.

The color in alcohol is whitish, with five rather narrow brown dorsal cross bands, alternating with 5 large poorly defined dark brown spots, the one on the caudal base best defined; a blackish spot some distance behind each eye; the top and sides of the head, and pectoral base are thickly sprinkled with dark brown dots and most of the scales are more or less outlined by minute brown dots. The first dorsal is barred by two dark cross-bands, the second dorsal and caudal by numerous rows of dark brown dots; the other fins are clear.

Described from the type and only specimen, 30 mm. long, collected 5 miles north of Kota Tinggi, Johore, Malay Peninsula. This fish has a strong resemblance to *Eugnathogobius macrops* H. M. Smith, which differs in having the first dorsal V, the second dorsal I–7, the anal I–6, in the very small eye, 15 times in the head and covered with skin, and emarginate tongue.

Paludosus, swamp dweller.

Mastacembelus keithi, new species. Plate XIX

Dorsal XXVI–56–58; anal III 54–60. There are 2 preopercular spines and one preorbital spine. The snout is naked, with a few scales between eye and nostril. The caudal is free from both dorsal and anal, but in very young specimens it is scarcely distinct. The last dorsal and anal spines are very small and more or less concealed in thick skin.

The type specimen is 191 mm. long, without caudal fin or rostral appendage. The greatest depth is 7·34, the head (without appendage) 5 times in the length. The eye is 10·85 times in the head, 3·4 times in the snout, which is 3·166 times in the head; the pectoral equals the snout. A paratype 125 mm. long has the depth 7·35, the head 5 times in the length. The eye is 10 times in the head, 3·2 times in the snout, which is 3·1 times in the head. The mouth does not extend to a vertical from the nostril. The rostral appendage equals the eye. The scales are very small, about 220 in a longitudinal series below the lateral line; there are 22 above and 32 below the lateral line, counted between the origins of the soft dorsal and anal. The vent is nearer the caudal than the head, and equidistant from the caudal base and pectoral axil.

The color in alcohol is dusky brown, with narrow vertical cross bars of very pale reddish brown or whitish, which divide the ground color into 20 or more dusky cross bars, wider than the pale bands, and descending to the abdominal region and anal fin. Scattered over the side and particularly abundant below

the lateral line are white dots or circular spots; a black stripe extends from the rostral tip across the eye to the angle of the opercle, and usually backward on the trunk for a distance nearly equal to the head. The dark bands on the body extend upward to form a row of dusky spots on the dorsal base; on the anal base is a row of white or clear spots. The soft dorsal and caudal are barred with dusky lines; the anal is dark brown, with a white margin. There is a dusky cross bar on the pectoral base.

The type and one paratype 128 mm. long were taken from a brook flowing into the Segaliud River. 7 paratypes, 58 to 125 mm. in length, were collected from the Kabili River. Both streams flow into the upper or southern end of Sandakan Bay, British North Borneo.

Two specimens, 172 and 212 mm. long, from the Gum Gum River, Sandakan district, have the dorsal XXVII–56; anal III–48–50, the second anal spine very large, the third one small and hidden. The head is 5·5 to 6 times in the length.

I take great pleasure in dedicating this fish to my friend H. G. Keith, conservator of forests for British North Borneo. To his hospitality and aid on my trips to Sandakan I am much indebted.

Petroscirtes kranjiensis, new species. Plate XX

Dorsal 34 (XII–22); anal II–24.

The depth is 5·33 to 5·5 times, the caudal 5, the head 4 to 4·16, the pectoral and ventral each 5 times in the length.

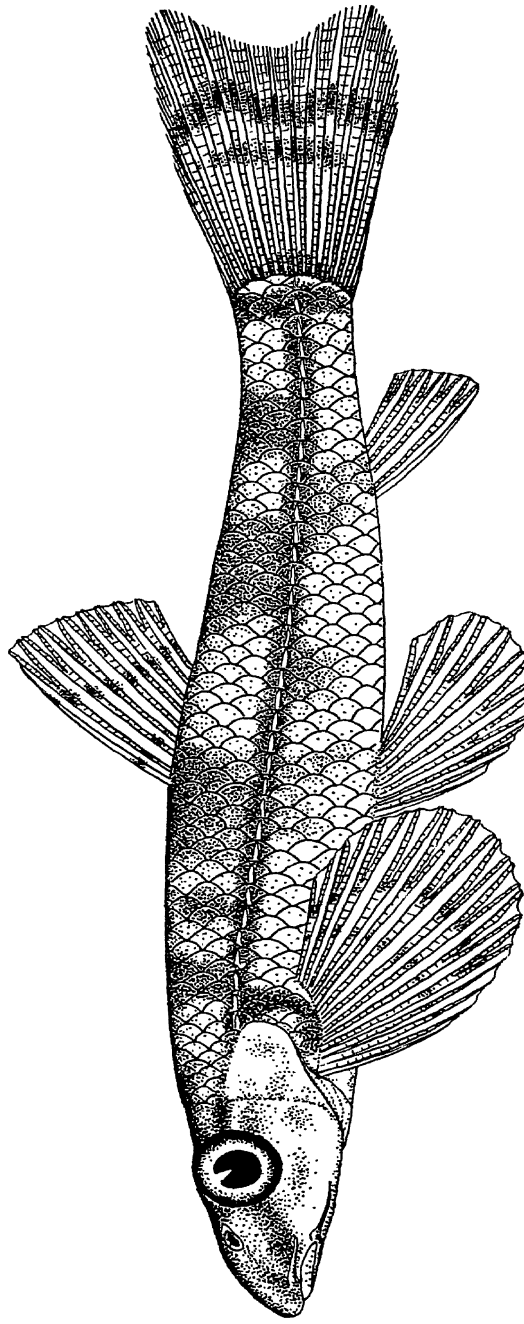
The eye is 4 to 4·2, the snout 4 to 4·3, the postorbital 1·9, the least depth of the caudal peduncle 2·6 to 2·7 times in the head; the interorbital is 1·8 times in the eye.

The slender, laterally compressed body is deepest at the dorsal origin, which is over the opercle, forward of the gill opening. The dorsal profile is convex from the nape to the tip of the snout, which is nearly vertical; the eye is far forward, flush with the profile; the mouth extends beneath the middle of the eye; the lower canines are moderately large, the upper canines at least half as large; the pectorals and ventrals do not extend to the vent; the dorsal is highest posteriorly 1·75 to 1·9 times in the head, the rays beyond the twenty-eighth shorter; the anal height is 3·2 to 3·5 in the head; no tentacles or dermal flaps.

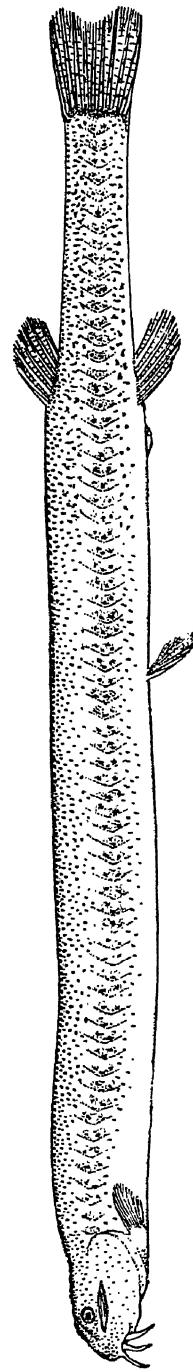
The color in alcohol is gray, with 16 indistinct cross bands, most distinct along the dorsal base and a short distance below; there is a narrow blue-black bar behind the eye, and a dark spot on the pectoral base. The fins are all densely sprinkled with minute brown specks; there are two dark spots, badly faded, at the caudal base; the smaller specimen has a black spot at the top of the three last dorsal rays.

Described from the type and paratype, 42 and 40 mm. in length, taken from a mangrove swamp drained by the Kranji River, Singapore Island.

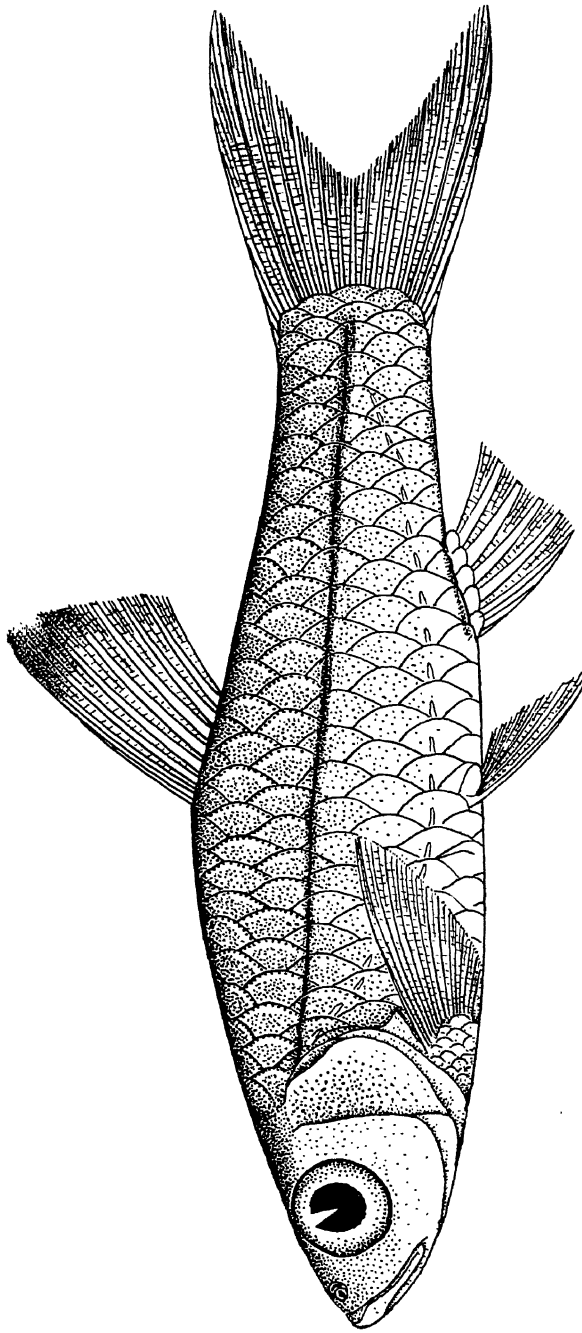
The types of the species here described are in the natural history museum of Leland Stanford Junior University, California, U.S.A. Where the material allows, paratypes are in the Raffles Museum, Singapore, and in the British Museum of Natural History. All measurements of length are to the caudal base.



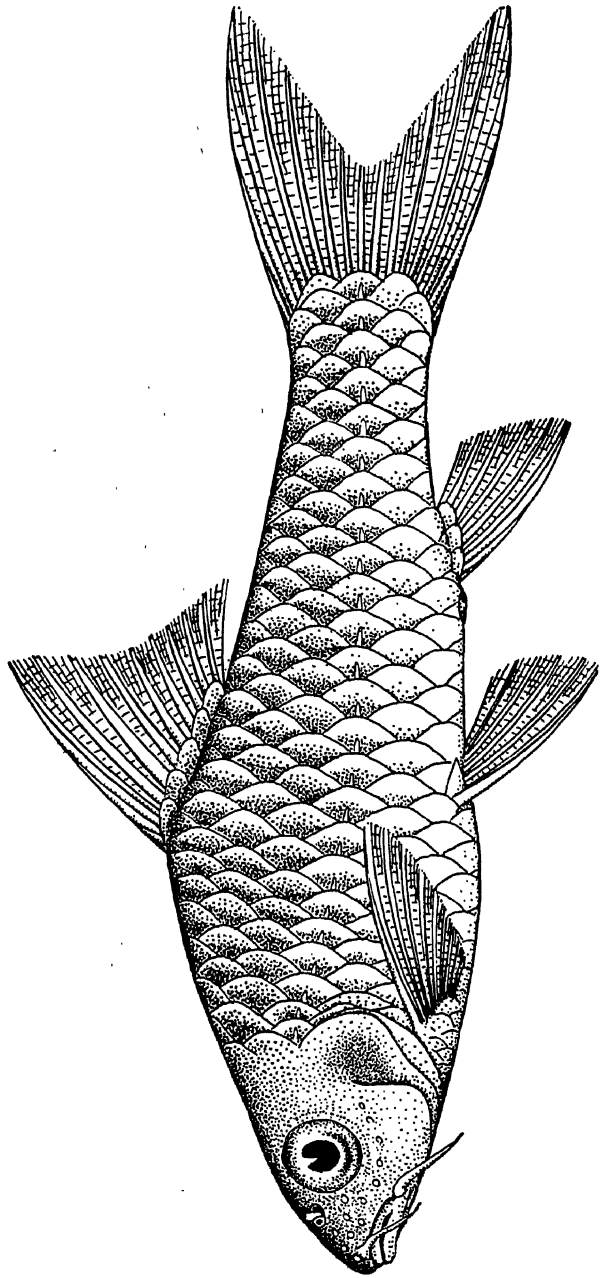
Homaloptera tweediei n.sp. (*Length of type 26 mm.*).



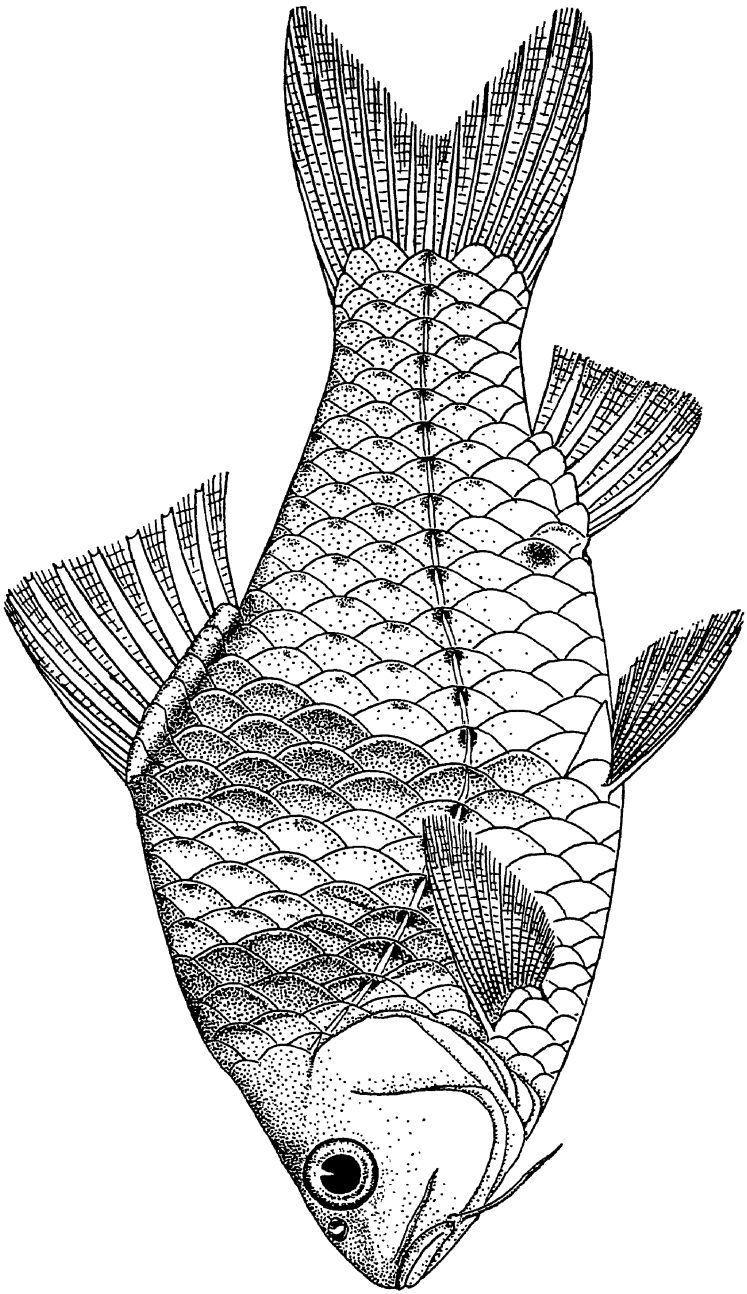
Cobitophis perakensis n.sp. *(Length of type 60 mm.).*



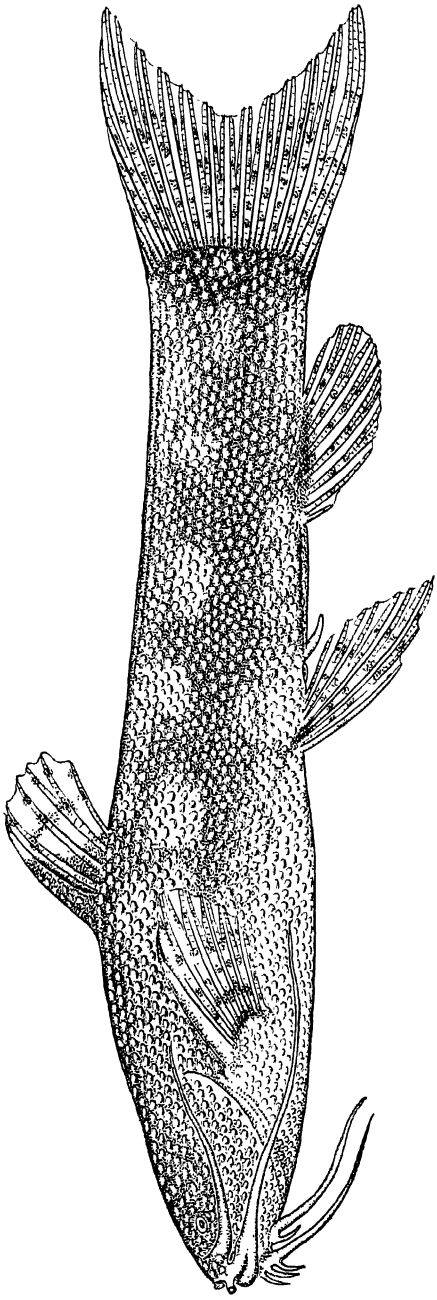
Rasbora dorsimaculata n.sp. *(Length of type 28 mm.).*

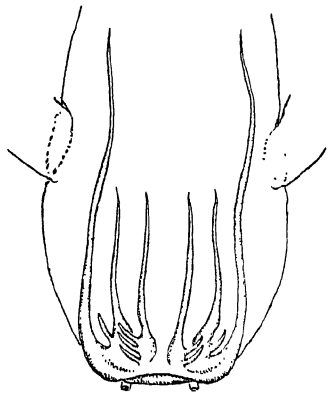


Lissochilus hendersoni n.sp. *(Length of type 70 mm.).*

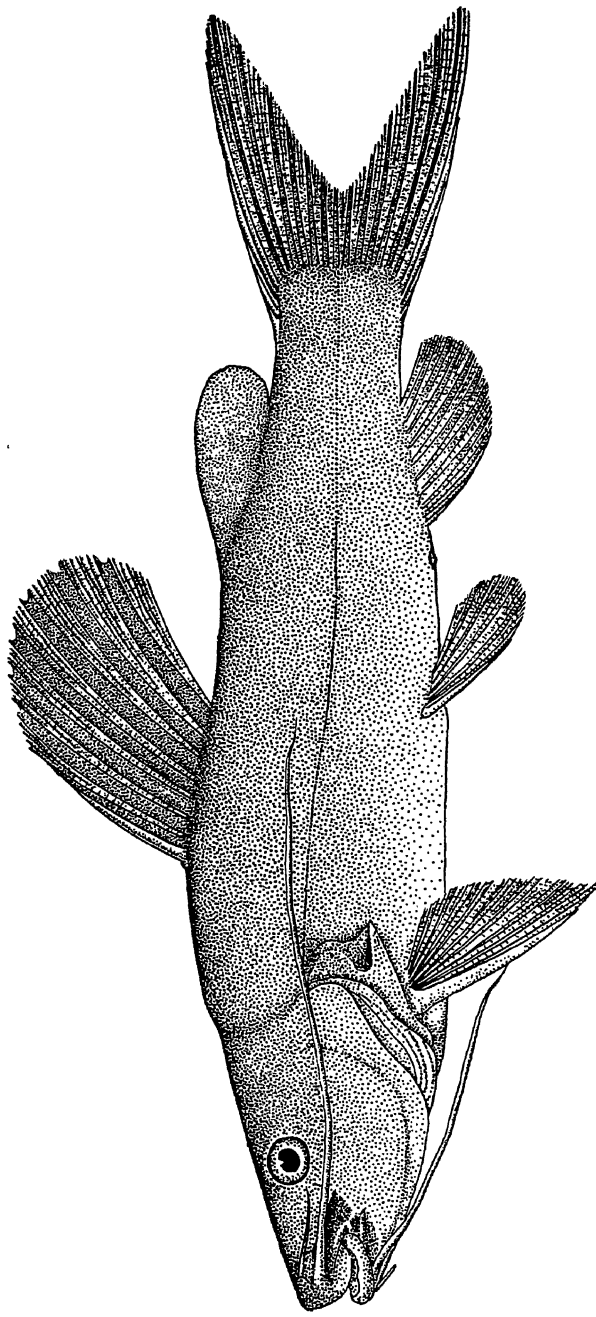


Puntius kuchingensis n.sp. (*Length of type 67 mm.*).

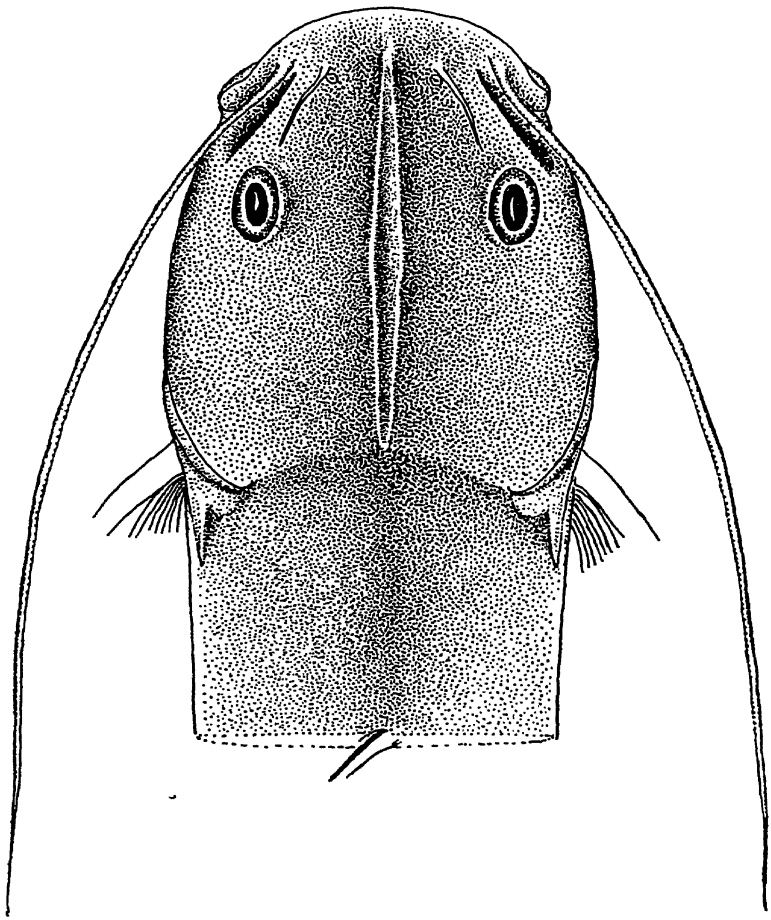




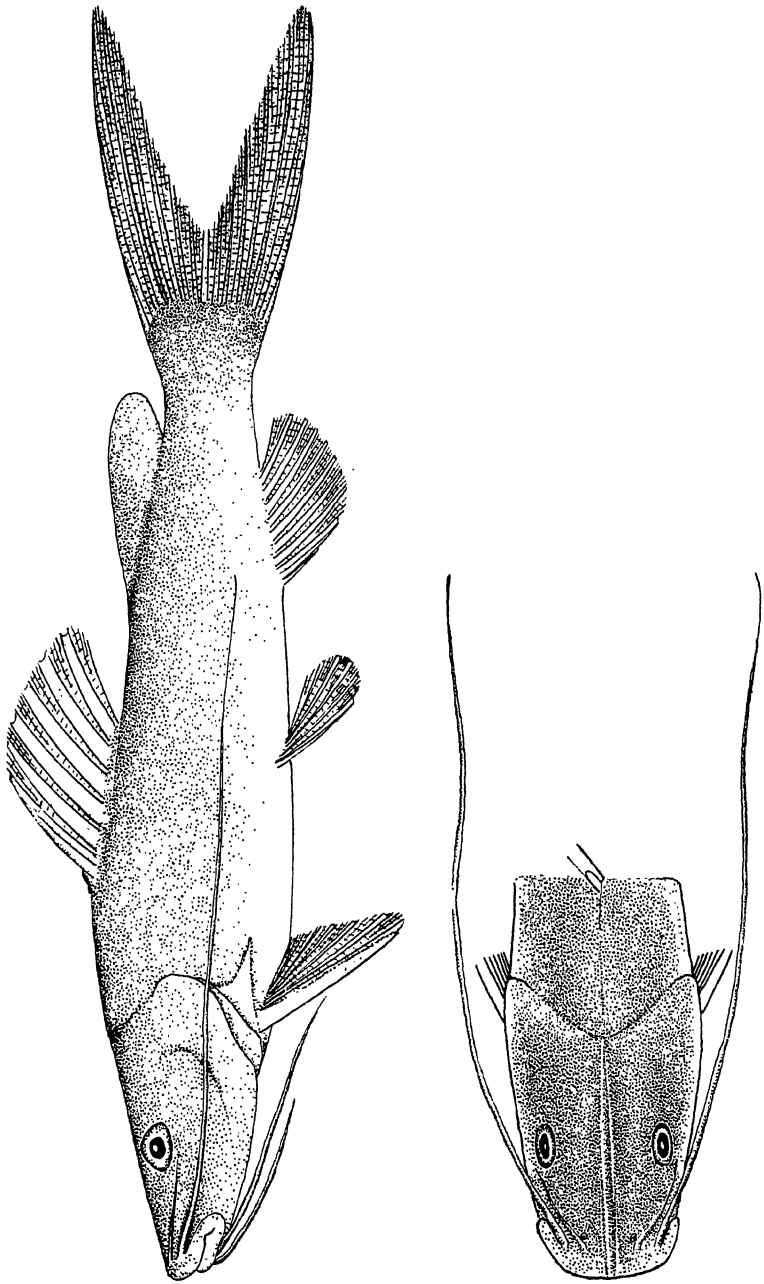
Parakysis verrucosa n.gen. and sp. *(Length of type 31 mm.).*



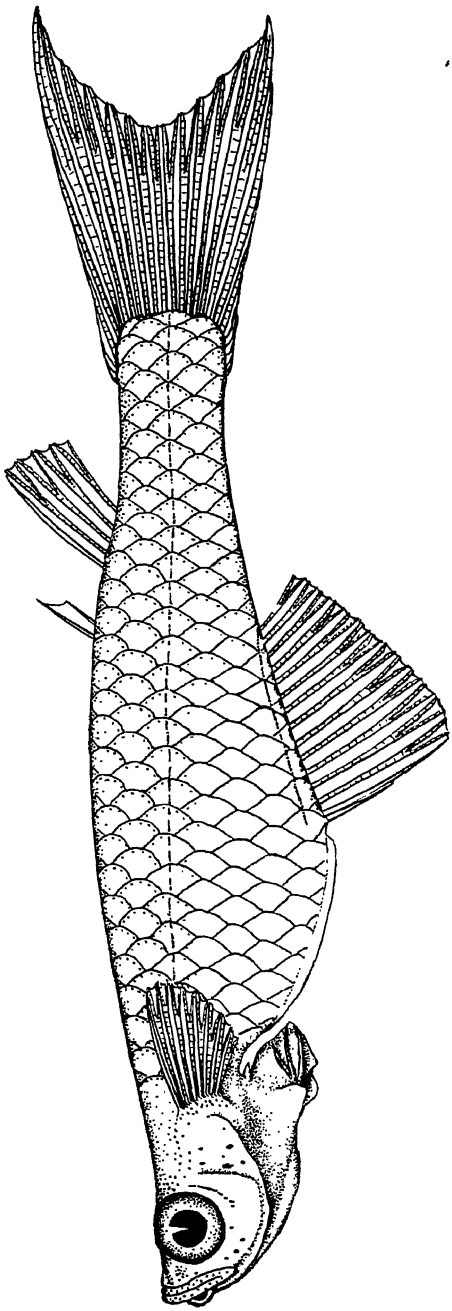
Mystus johorensis n.sp. *(Length of type 208 mm.).*

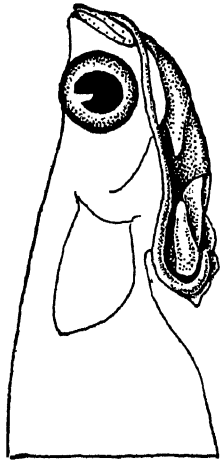


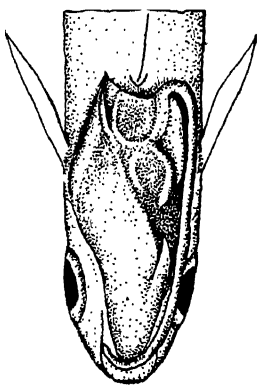
Mystus johorensis n.sp. *(Length of type 208 mm.).*



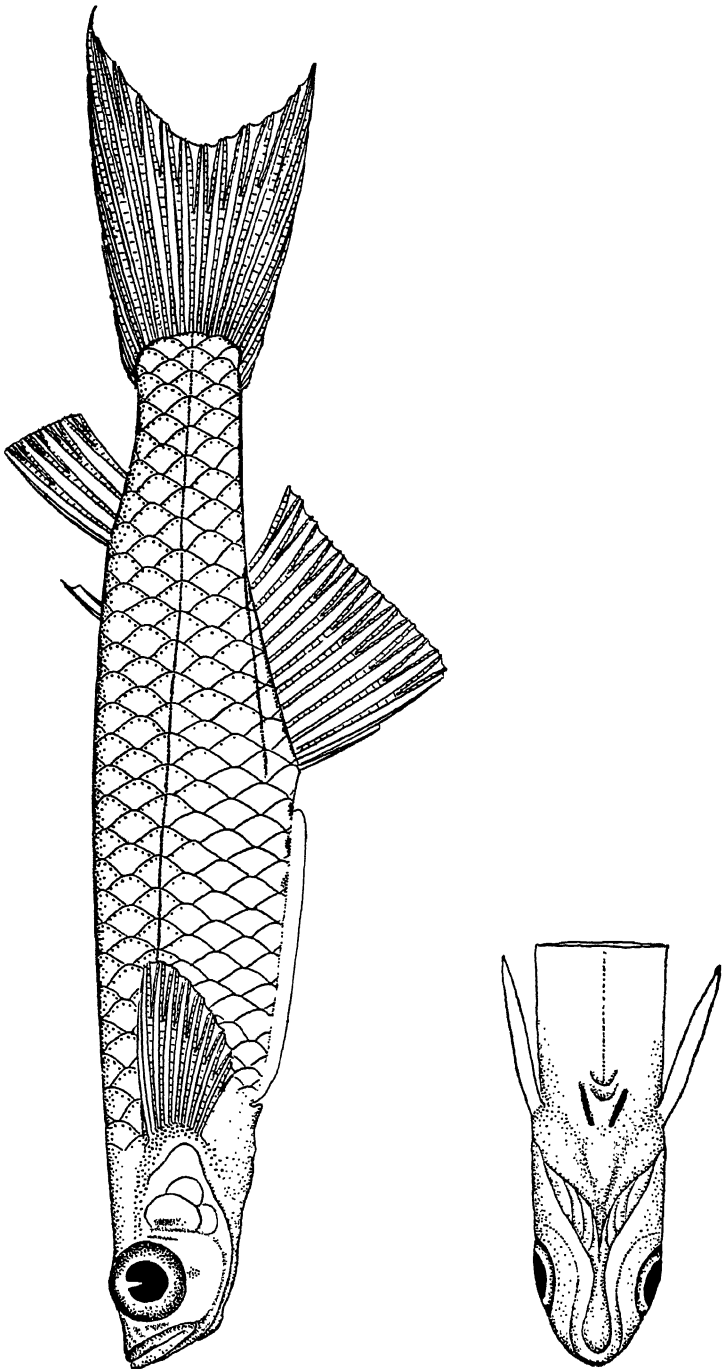
Mystus pahangensis n.sp. (*Length of type 196 mm.*).



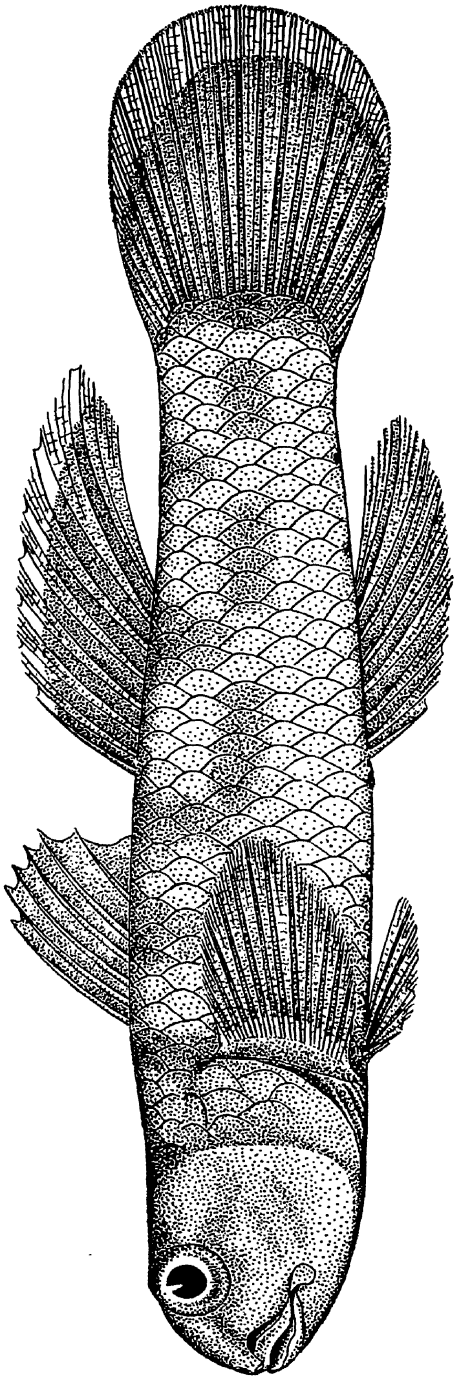




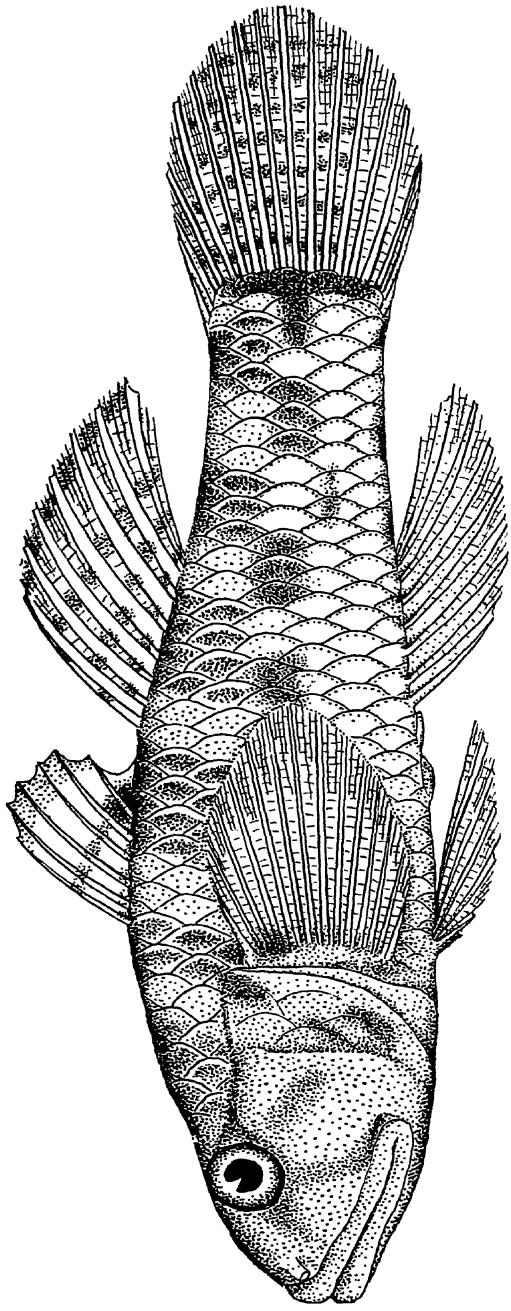
Neostethus borneensis n.sp. male. *(Length of type 21·5 mm.).*



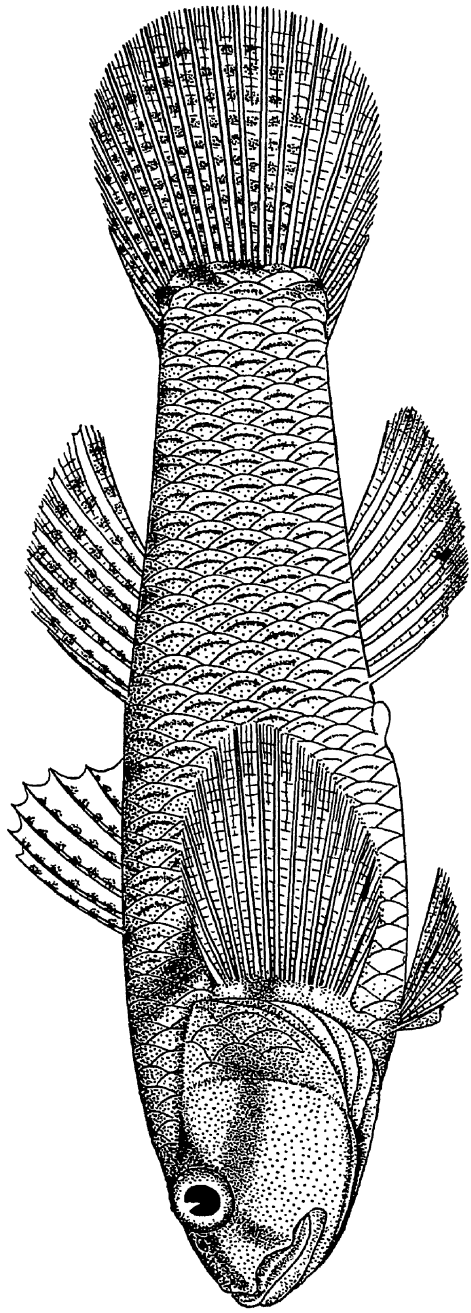
Neostethus borneensis n.sp. female. (*Length of type 24·5 mm.*).



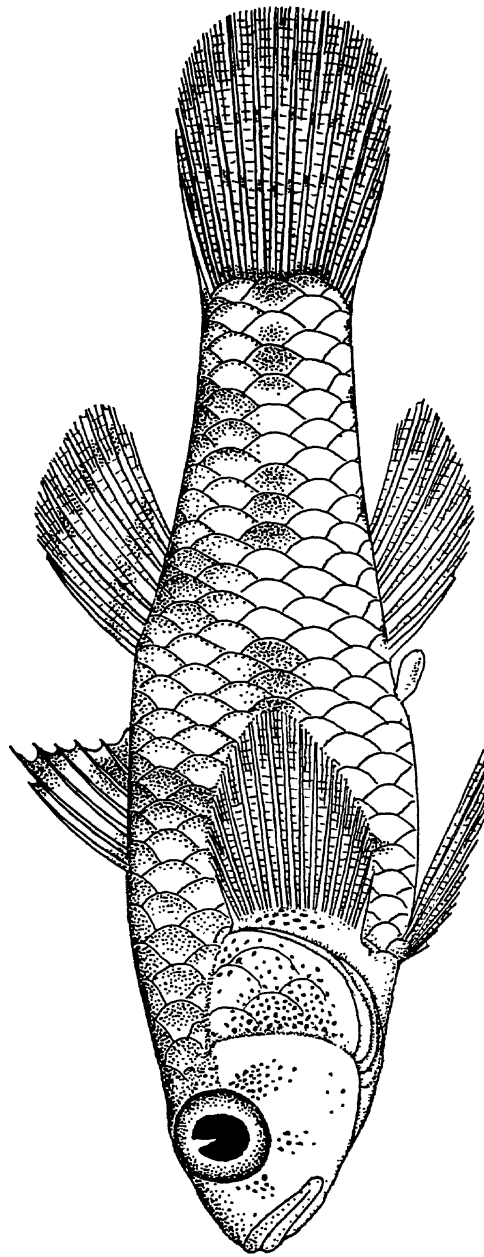
Vaimosa avicennea n.sp. *(Length of type 30 mm.).*



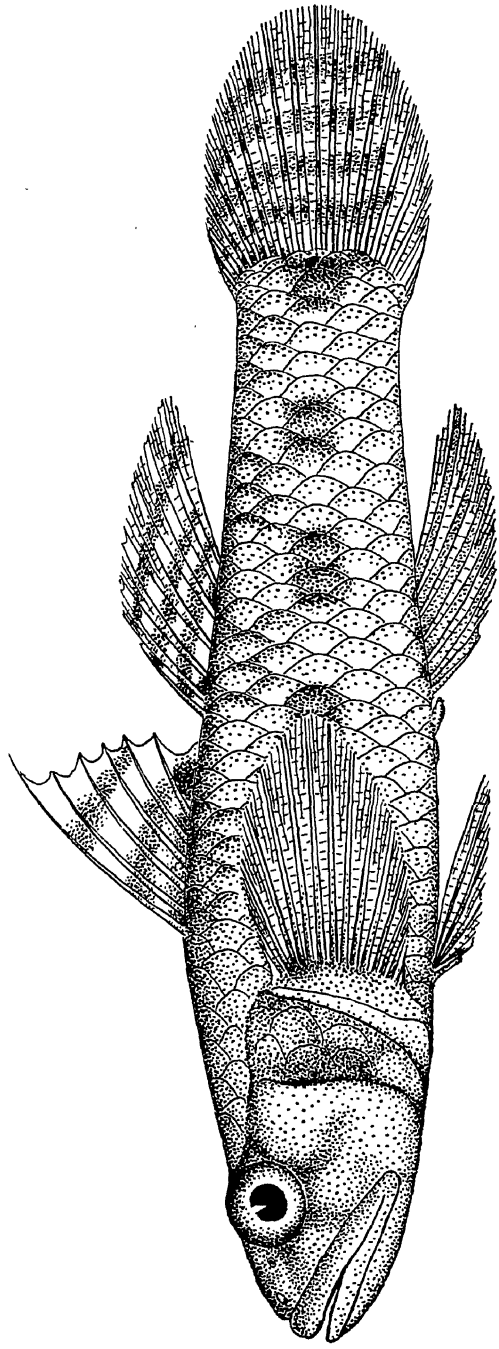
Vaimosa jurongensis n.sp. *(Length of type 35 mm.).*



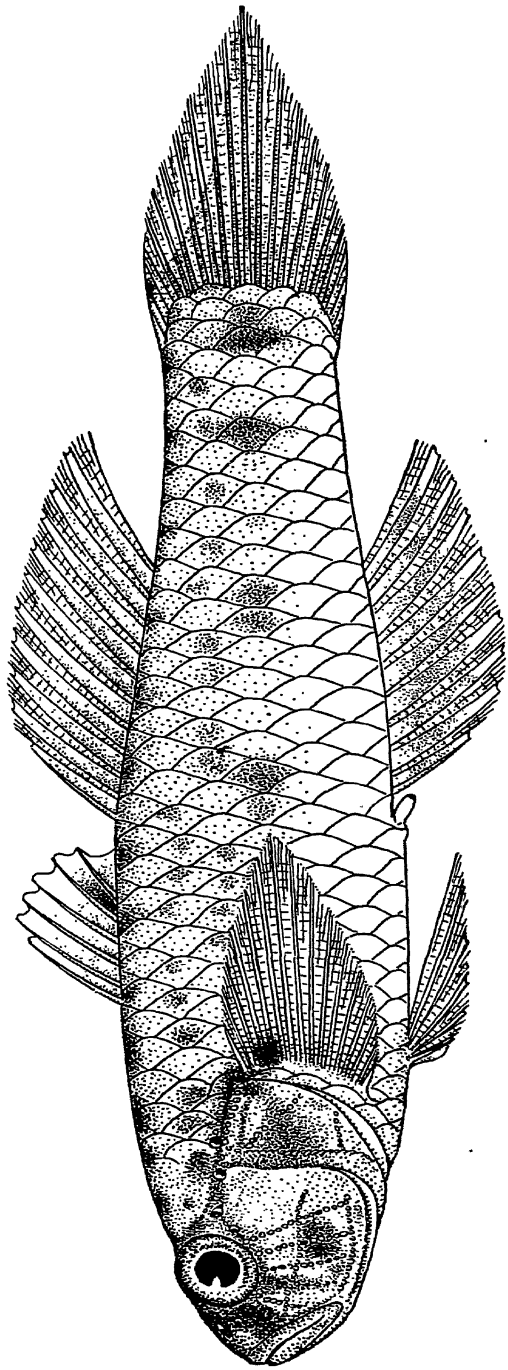
Vaimosa kabilia n.sp. *(Length of type 36 mm.).*



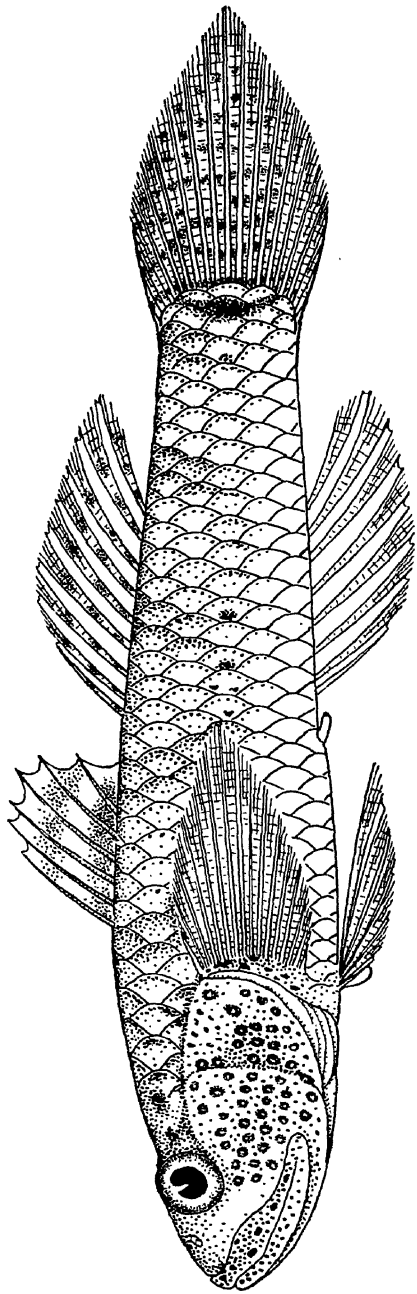
Vaimosa oratai n.sp. *(Length of type 18 mm.).*



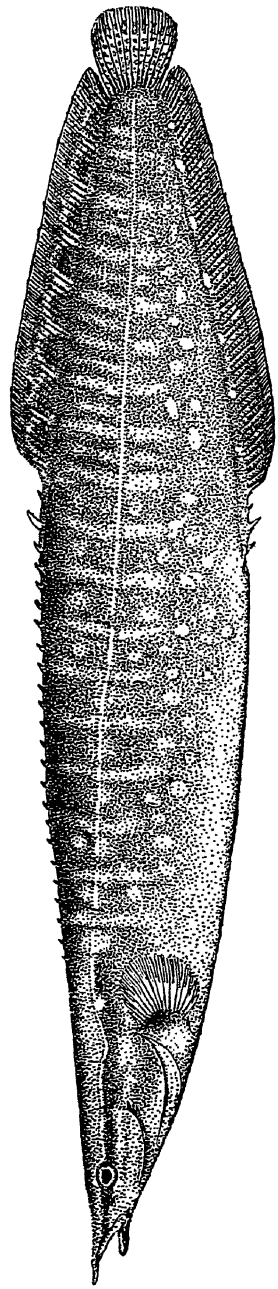
Vaimosa perakensis n.sp. *(Length of type 25 mm.).*



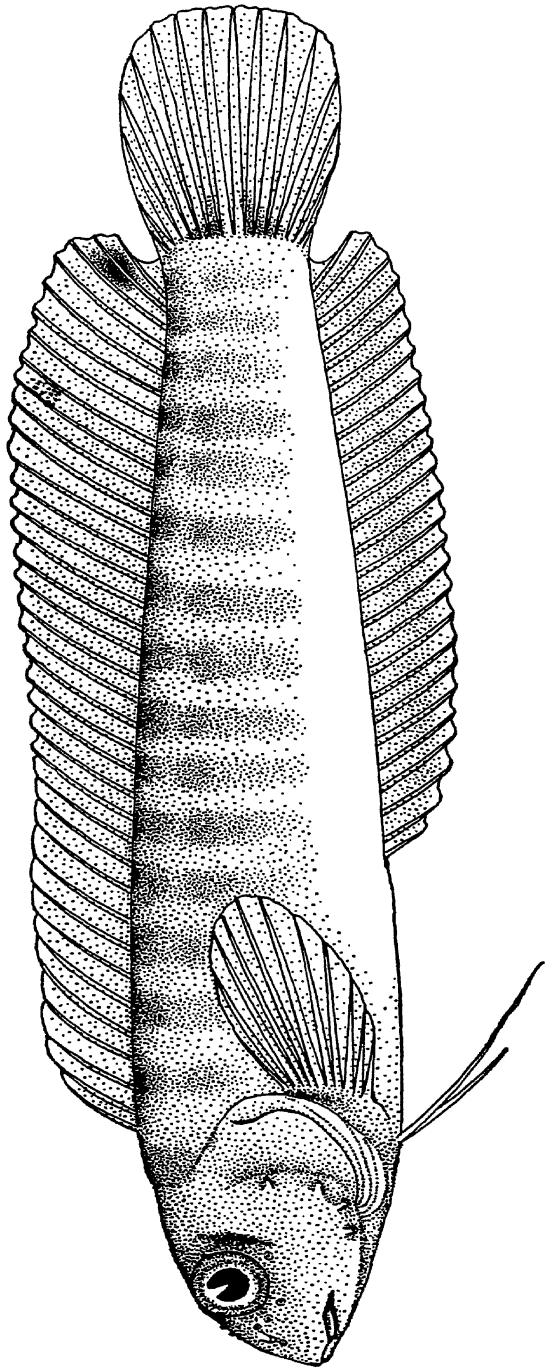
Ctenogobius kranjiensis n.sp. *(Length of type 29 mm.).*



Ctenogobius paludosus n.sp. *(Length of type 30 mm.).*



Mastacembelus keithi n.sp. *(Length of type 191 mm.).*



Petroscirtes kranjiensis n.sp. *(Length of type 42 mm.).*

Additions to the fish fauna of Malaya and notes on rare or little known Malayan and Bornean fishes

By ALBERT W. C. T. HERRE, PH. D.

Curator of Fishes

Stanford University, California, U.S.A.

Recent years have seen a great increase in our knowledge of the fishes of Malaya and their distribution. Extensive collections by the Department of Fisheries, under the guidance of Director W. Birtwistle, by Mr. M. W. F. Tweedie, curator of the Raffles Museum, and by myself have added hundreds of fishes to the known fauna of Malaya, and extended knowledge of their range immensely. The results have been made known in papers by Fowler, Tweedie, Herre, and Herre and Myers. Nevertheless we still lack an adequate knowledge of either the fresh water or brackish water and marine fishes of the Malay Peninsula. Intensive collecting is necessary in all the Malay States and even on Singapore Island before the fresh water fishes are properly known, while the marine forms are very inadequately known as yet. Most of the fresh water fishes of Sumatra and a large proportion of Bornean species will ultimately be discovered in the Malay Peninsula. In addition others known as yet only from the streams of Siam and Burma will be found in Malaya. I do not doubt that a few more years of exploration will show a fish fauna of 1,200, possibly 1,500 species in the fish fauna of Malaya.

The Malayan fishes are an integral part of the Indo-Pacific fauna, and the fresh water fishes cannot be considered apart from the natural biological realm which extends from Cambodia, Siam, and Sumatra eastward to Wallace's Line, and includes Palawan and Mindanao in the Philippines, as well as Borneo and Java.

All measurements of length are from the snout tip to the caudal base, unless otherwise specified. The asterisk indicates species believed to be additions to the fish fauna of Malaya. Nearly all were obtained by Mr. Tweedie and myself in 1937.

DASYATIDÆ

***Dasyatis bleekeri** (Blyth)

There is a cast of a large specimen in the Raffles Museum, taken near Singapore.

CHIROCENTRIDÆ

Chirocentrus hypselosoma Bleeker

A specimen 146 mm. long was obtained at Singapore. Gill rakers 5 plus 18. Although originally described from Singapore, all authors since Bleeker have ignored this species until it was investigated by Hardenberg. See his "Remarks on the Genus Chirocentrus" in TREUBIA, vol. XII, pp. 51–65, May, 1930.

SYNBRANCHIDÆ

Mactrotrema caligans (Cantor)

A specimen of this rare eel, 148 mm. long, was obtained from fishermen seining on the beach near Singapore. It has been reported only from Penang and Singapore, but must occur all along the coast in suitable localities. The wide gill openings, extending upward to the lateral line, and its habitat in the sea, serve to distinguish this species and separate it from the other Synbranchid eels.

OPHICHTHYIDÆ

***Pisoodonophis micropterus** (Bleeker)

A specimen 562 mm. long was collected on a Singapore reef. The depth is 40, the head 12 times in the length; the head is 3·9 times in the trunk. The eye is 14·8 times in the head; the posterior nostril is below the anterior part of the eye.

MURÆNIDÆ

***Uropterygius concolor** (Rüppell)

A specimen of this finless moray, 270 mm. long, was secured at Singapore. A thick fold of skin along the back resembles a dorsal fin extending from head to tail tip. Dissection shows that it is not a fin, as it does not contain a single fin ray. There is no trace of an anal fin.

CYPRINIDÆ

***Macrochirichthys macrochirus** (Cuv. and Val.)

Four fine specimens, 235 to 298 mm. in length, from Chenderoh Dam, Perak. A fish of Sumatra, Java, Borneo, and Siam.

Laubuca johorensis (Steindachner)

A single specimen, 48 mm. long, from the Mawai District, Johore. Dorsal 9; anal III–28; scales in lateral line 44. A silvery black line runs along the middle of the side, terminating

in a black spot on the caudal base. The opercles are bright silver. First noted by Steindachner in 1870, from Johore, it was reported by Duncker in 1904 from Kuala Lumpur and Negri Sembilan, and apparently has not been seen since until this record.

*__Rasbora vaillanti__ Popta

Sixty specimens, 30 to 73 mm. in length, were taken from the lake at Chenderoh Dam, Perak. The pectorals are longer than the head. Another specimen, 87 mm. long, from the Rejang River, Sarawak, Borneo. Hitherto known only from Borneo.

__Rasbora maculata__ Duncker

Two examples, each 16 mm. long, were taken by Mr. Tweedie near Kota Tinggi, Johore. As pointed out by Herre and Myers, this beautiful and tiny fish is very distinct from *Rasbora kalochroma*, with which it has been confused by authors and under which it is placed in Fowler's List of Malayan Fishes. Duncker's specimens came from northern Johore, near Muar or Bandar Maharani, while I have previously obtained it from near Jasin, Malacca.

*__Brachydanio albolineata__ (Blyth)

A specimen 26 mm. long was taken from the brook at the Botanic Garden, Penang, and 46 specimens, 20 to 32 mm. in length, from a brook near Sauk, Perak. This species is lovely sky blue in life, with an orange stripe along the middle of the side, from below the dorsal to the caudal peduncle and middle of the caudal base. Hitherto known only from Burma.

__Danio regina__ Fowler

A specimen 61 mm. long from the Muar River, Negri Sembilan; this is the second record from Malaya of this Siamese fish. Dorsal II–11; anal III–14. Scales in the lateral line 34, plus 3 on the caudal base; the head is 4 times in the length.

*__Dangila siamensis__ Sauvage

Four specimens 152 to 218 mm. in length were caught at Chenderoh Dam, Perak, where it is a common food fish.

Dorsal III–25 or 26, or IV–25; anal III–5. Scales in lateral line 35 or 36, plus 2 on the caudal base, 6½ or 7 above and 4½ below the lateral line to the ventral origin; 6 scales below to the anus and 7 to the median line on the breast. There is a black blotch at the caudal base and 9 or 10 longitudinal rows of black spots, one on each scale; the dorsal has a submarginal black band, the other fins all clear.

__Osteochilus spilurus__ (Bleeker)

Two specimens, 20 and 25 mm. long, were taken from a brook on Mandai Road, Singapore, the first record from the

island. Fourteen others, from 16 to 61 mm. in length, were caught in the Mawai district, Johore.

Scales 27, plus 2 on caudal base. A large black spot on the caudal base, and a small one below the lateral line and 3 scales behind the head.

***Tor soro** (Cuv. and Val.)

A fine specimen 149 mm. long was taken from the lily pool in the Penang Botanic Garden. Hitherto known from Sumatra and Java.

Probarbus jullieni Sauvage

In 1934 I obtained an example of this very striking looking fish from Chenderoh Dam, Perak. In March, 1937, numerous very large specimens were seen in the market at Kuala Kangsar, Perak, on several occasions, their lengths over all being from half to three-fourths of a meter. They were all too large for any available containers, so none could be taken. This is a highly prized fish of Indo China and Siam.

Cyclocheilichthys armatus (Cuv. and Val.)

A specimen 48 mm. long was taken at Chenderoh Dam, Perak, where two large examples were obtained in 1934. A juvenile specimen 24 mm. long was taken in the hills 5 miles north of Kota Tinggi, Johore.

Scales in the lateral line 34, plus 2 on the caudal base. The depth equals the head, 3·2 times in the length; the very deeply forked caudal is 2·4 times in the length. The eye is greater than the interorbital, 2·7 times in the head.

***Cyclocheilichthys de zwaani** (Weber and De Beaufort)

A specimen 166 mm. long was obtained from the Perak River, below Chenderoh Dam, Perak. The small eye is more than 4 times in the head, and 1·5 or more in the postorbital part of the head; 4 minute barbels; the pectorals do not reach the ventrals; 16 scales around the caudal peduncle.

An example 140 mm. long was also secured at Kuching, Sarawak, Borneo. Hitherto known only from Sumatra.

***Cyclocheilichthys repasson** (Bleeker)

Seven specimens, 21 to 88 mm. in length, were taken from a brook at Sauk, Perak.

Twenty scales around the caudal peduncle; 4 small barbels; eye 3 to 3·5 times in the head. Previously known from Sumatra, Borneo, and Siam.

***Puntius dunckeri** (Ahl.)

This species is often confused with *Puntius everetti*. It occurs in great numbers in Gunong Pulai Reservoir, Johore, but the schools remained in deep water, too far off shore to be taken

by any available means. From a creek on the Mandai Road, Singapore, 5 specimens, 52 to 85 mm. in length were taken; 6 from the Gunong Pulai Reservoir, 73 to 115 mm. in length; and 16 from 35 to 85 mm. from a hill stream 8 miles north of Kota Tinggi, Johore.

***Puntius sumatranus** (Bleeker)

One example, 30 mm. long, from Kuala Pilah, Negri Sembilan.

Puntius binotatus (Cuv. and Val.)

This wide spread and highly variable fish was collected in many localities. Weber and De Beaufort give the fins and scales as follows:—Dorsal IV–8; anal III–5; pectoral I–15–17; ventral I–8 or 9; lateral line 23–27; predorsal scales 9 or 10.

My own counts, based entirely on typical Philippine specimens, are Dorsal IV–8; anal III–5; pectoral I–14 or 15; ventral I–8; scales in lateral line 22–25; predorsal scales 8 or 9.

***Puntius binotatus banksi,** new subspecies

Among those collected in Singapore and Johore, and near Kuching, Sarawak, Borneo, are others showing a lower number of scales in the lateral line, and markings different from those recorded in the literature.

Pectoral rays I–12 to 14, mostly I–13, often I–14; scales in lateral line 20 to 22, nearly all specimens 21, plus 1 or 2 on the caudal base.

Twenty-five specimens, 13 to 76 mm. in length, from a pond in the Botanic Garden, Singapore, have a transverse bar from dorsal to abdomen in very young stages, in addition to the typical markings of *P. binotatus.* As they get larger most of the markings disappear, leaving a broad black bar from the dorsal downward for 3 or 4 scales, and a spot at the caudal base. Ten specimens from 46 to 94 mm. in length, from a hill stream 5 miles north of Kota Tinggi, Johore, and 4 specimens 75 to 94 mm., in length, from a stream 16 miles north-east of Kota Tinggi, agree with the above in all respects, except that they lack the typical markings of *Puntius binotatus.*

Twenty-two specimens, 38 to 67 mm. in length, from a brook 18 miles east of Kuching, Sarawak, Borneo, show no trace of the characteristic markings of *Puntius binotatus,* but have an elongate black bar or stripe from the base of the fourth dorsal spine downward over 3 or 4 scales; this bar is usually one scale in width, but may run between scales and extend over half of each scale on each side; there is a small black spot on the caudal peduncle just before the caudal base.

Scales 21 (22 in 2 specimens) plus 1 or 2 on the caudal base; pectoral I–12–14. Dorsal origin opposite the 9th or 10th scale

of the lateral line, instead of the 8th or 9th as in typical *P. binotatus*. The length of the head is 3·2 to 3·3 times in the standard length, instead of 3·4 to 3·8 in my typical *P. binotatus* (or 3·6 to 3·9 according to Weber and De Beaufort). The dorsal is gently curved instead of being truncate.

Named in honor of Mr. E. Banks, Curator of the Sarawak Museum, without whose kindly aid little could have been done during my brief stay in Kuching.

Puntius birtwistlei, new species

Dorsal IV–8; anal III–5; scales in lateral line 24 or 25 plus 2 on caudal base; 4½ above and 2 below lateral line to ventral origin or 3 below to anus; predorsal scales 8, 9, 10; scales around caudal peduncle 11.

The body is elongate, moderately compressed, elevated at the dorsal, the anterior profile usually a straight line from dorsal origin to snout, or it may have an elevation at the nape; the snout is rather blunt, rounded, with included lower jaw. The depth is 2·85, the head 4 to 4·25, the deeply forked caudal about 3 times in the length. The eye is 4·33 to 4·44 times in the head and much shorter than the snout or interorbital width, 1·45 to 1·5 times in the snout and 1·6 to 1·66 in the interorbital. The snout is about 2·95, the interorbital 2·6 to 2·75 times in the head. The rostral barbels equal or nearly equal the eye; the maxillary barbels are slightly longer. The dorsal origin is about opposite the ventral origin and is distinctly nearer the tip of the snout than the caudal base, above the 9th scale of the lateral line, or sometimes over its hind margin. The fourth dorsal spine is broad, strong, with about 20 (rarely 17) strong teeth along its hind margin, the bony part equalling the head. The third anal spine equals the ventral length and almost equals the head. The pectoral length is distinctly less that that of the head, 4·7 to 5 times in the length, not reaching the ventrals, and the latter not reaching the anal. The least height of the caudal peduncle is 1·2 to 1·33 times in its own length, and 1·75 to 1·9 times in the head. The upper margin of the dorsal is markedly concave.

The color in alcohol is uniform reddish brown, the scales on the upper half with a more or less evident dusky hind margin; 2 specimens have a narrow blackish margin on the caudal and dorsal.

Six examples, 175 to 242 mm. in length, from Chenderoh Dam, Perak. This large carp is much used for food and is close to *P. bramoides*, from which it differs in scalation, smaller eye, longer snout, broader interorbital, dorsal position, lesser depth, etc.

I take pleasure in naming this species after Director of Fisheries W. Birtwistle, who has aided me greatly in studying Malayan fishes.

Balantiocheilus melanopterus Bleeker

Eleven specimens, 138 to 174 mm. in length, were obtained from the Perak River, below Chenderoh Dam, Perak. This handsome and boldly marked food fish is caught in considerable quantity in the boiling current below the dam; second record from this locality, but not known as yet elsewhere in the Peninsula.

Epalzeorhynchus siamensis H.M. Smith

Three specimens of this rather rare fish were caught in the lake above Chenderoh Dam, Perak, their lengths 43 to 70 mm. First definite record from the Peninsula.

Epalzeorhynchus kallopterus Bleeker

Four specimens of this very handsome cyprinid were caught about a float in the lake above Chenderoh Dam, Perak, their lengths 36 to 43 mm. This fish is now reported from Perak, Pahang, Negri Sembilan, and Malacca.

COBITIDÆ

Acanthopsis choirorhynchus (Bleeker)

Dorsal II–10 or 11; anal II–5; depth 8 to 8·5, the head 4 or a trifle more than 4 times in the length, the eye is 8 to 8·6 times in the head.

The color in alcohol is uniform pale brown or tan, with a small dark spot at the upper part of the caudal fin.

Two specimens, 163 to 175 mm. in length, from the Muar River in Negri Sembilan.

Acanthophthalmus kuhli (Cuv. and Val)

Forty specimens, 24 to 56 mm. in length, from a roadside ditch in the Mawai District, Johore, and 4 from 34 to 47 mm. in length, from a stream 5 miles north of Kota Tinggi, Johore.

This species is subject to a good deal of variation in depth, and preserved specimens are apt to be a good deal thicker than in life. Their pinkish color is conspicuous in active living specimens, contrasting with their dark transverse bars. They occur in great abundance in ditches containing only a few inches of water and entirely filled with a dense mat of filamentous green algæ. In such places they have plenty of food and are amply protected from enemies and the direct heat of the sun.

***Lepidocephalus hasselti** (Cuv. and Val.)

Two specimens, 20 and 34 mm. in length, were collected in the Mawai District, Johore. Common in Sumatra and Java.

***Nemacheilus fasciatus** (Cuv. and Val.)

A specimen 29 mm. long was taken from a stream 5 miles north of Kota Tinggi, Johore. Common in Sumatra, Java, and Borneo.

Nemacheilus selangoricus Duncker

Mitteil. Naturhist. Museum, Hamburg, XXI, p. 175, 1904.

Dorsal II or III–9; anal I–5; pectoral I–10 or 11; scales minute, about 160 in longitudinal series, the lateral line with about 112 tubules; predorsal scales 60 to 65; scales from dorsal origin to lateral line 18 or 20, and 16 from lateral line to ventral origin.

The depth is 5·4 to 5·8, the head 4, the caudal 3, the pectoral 4 to 4·66, the ventral 5·7 to 6, the dorsal height 4·4 to 4·8, the anal height 6 to 6·15 times in the length. The eye is 4·75 to 4·95 times in the head, 1·66 to 1·9 times in the snout, and 1·4 to 1·5 times in the interorbital. The snout is 2·5 to 2·9 times in the head, the interorbital 3 and a third times. The dorsal height is about nine-tenths as long as the head, the anal height about 1·5 times in the head. The ventral origin is beneath the second dorsal spine or first divided ray. The anal origin is much nearer the caudal base than to the ventral origin. The ventrals fall far short of the anal fin; the caudal is deeply forked, with pointed lobes. Most specimens have a conspicuous hook extending backward from the preorbital at the lower end of the front margin of the eye, as has been recorded for several other species of *Nemacheilus*.

The elongate body is little compressed anteriorly but markedly so posteriorly, its greatest depth midway between pectorals and dorsal, the head somewhat depressed with round-pointed snout. The small lunate mouth equals the eye, its lips papillate-striate, the lower lip with a median groove. The outer rostral barbels are longest, 1·25 to 1·33 times in the head, the maxillary barbels twice in the head; the inner rostral barbels extend to the middle of the eye.

In preserved specimens there are 11 to 13 broad dark brown cross bands over the back and down the sides, some of which may be irregular or divided, separated by narrow pale yellow stripes like the color of the belly. Three more or less distinct cross bands on the head, the first on the snout, the second over the eyes and down the cheek to the under side of the head, the third behind the eyes; the first and third bands usually are only blackish patches on top of the head. The caudal has black spots or a black band at its base, with 2 or 3 cross bars of dusky spots. The dorsal has a black spot at the base of the first two rays, and 2, rarely 3, stripes formed of black spots on the rays, across its middle and upper portion. The other fins are colorless.

Described from 15 specimens, 19 to 42 mm. in length, from the Balung River, 45 miles from Tawau, British North Borneo. Four specimens from a brook beside Mandai Road, Singapore Island, are 32 to 48 mm. in length; they have larger eyes, 3·75 to 4·3 times in the head, which is 4 to 4·5 times in the length.

Mr. Tweedie also obtained 4 near Kota Tinggi, Johore, their lengths 19 to 38 mm.

Previously known from Selangor, Singapore, and Perak, but very imperfectly described and not well separated, therefore, from other loaches of the same genus.

CHACIDÆ

Chaca chaca (Buch. Ham.)

A fine example of this peculiar catfish, 126 mm. long, was caught with a dip net in a small and rather rapid creek in the Mawai District, Johore.

CLARIIDÆ

***Clarias nieuhofi** Cuv. and Val.

A specimen 132 mm. long was taken from a hill stream 8 miles north of Kota Tinggi, Johore.

SILURIDÆ

Kryptopterus macrocephalus Bleeker

Four specimens, 44 to 59 mm. in length, were collected by Mr. Tweedie near Kota Tinggi, Johore, Second record from Malaya, the first being from Bukit Merah, Perak.

***Ompok leiacanthus** (Bleeker)

A specimen 88 mm. long, from a stream on the Mandai Road, Singapore.

***Silurichthys indragiriensis** Volz

Three specimens, 94 to 102 mm. in length, were collected in the Jurong District, Singapore Island, and 2 examples 74 and 93 mm. in length from a hill stream 5 miles north of Kota Tinggi, Johore.

Anal rays 48 or 49; the ventrals are behind the dorsal fin.

PANGASIIDÆ

Pangasius micronema Bleeker

Five specimens, 193 to 220 mm. in length, were obtained at Chenderoh Dam, Perak; previously reported from Bukit Merah, Perak.

This excellent food fish is common in the swift currents of the Perak River below the dam. It is much dreaded by fishermen, as the spines inflict very painful stinging wounds.

SISORIDÆ

***Glyptothorax majus** (Boulenger)

Dorsal I–6; anal III–9; pectoral I–8. The depth is 4·5 times in the length; the breadth of the occipital process is 2·5 times in its own length, and the least depth of the caudal peduncle

is 1·6 times in its own length. The dorsal and anal heights are equal, 5·33 times in the standard length. The following specimens were collected and studied:—1 of 39 mm. from Singapore Island; 4 from 25 to 54 mm. in length from a hill stream 5 miles north of Kota Tinggi, Johore; 1 of 48 mm. from a mountain brook 18 miles north-east of Kuala Lumpur, Selangor; and one of 47 mm. from the Benus River, Pahang. A Bornean species.

***Glyptothorax platypogonoides** (Bleeker)

A specimen 46 mm. long from a mountain brook 14 and ¾ miles north-east of Kuala Lumpur, Selangor, and one of 94 mm. from a stream at an altitude of nearly 3,000 feet, 18 miles north-east of Kuala Lumpur. A Sumatran fish.

ARIIDÆ

***Arius microcephalus** Bleeker

Two specimens, each 185 mm. long, were obtained from the market at Kuala Kangsar, Perak, where large numbers of this and other catfishes are kept alive. Previously known only from Borneo.

Arius truncatus Cuv. and Val.

Three examples, 214 and 242 mm. in length, were purchased with the above at Kuala Kangsar. Previously reported from Penang.

BAGRIDÆ

***Leiocassis bicolor** Fowler

Dorsal I–5 or 6; depth 6 times in the length; dorsal spine 3·33 times in the head. Two specimens, 24 and 38 mm. in length were taken by Mr. Tweedie in the Mawai District of Johore. Previously known only from Siam. Our specimens agree with Fowler's description and figure.

***Mystus wycki** (Bleeker)

Two fine typical specimens, 275 and 350 mm. in length, were obtained at Chenderoh Dam, where so many rare food fishes are caught. The very broad flat head, prominent rounded snout, and smooth upper surface of the head make this fish easily recognizable. Previously known only from Java and Sumatra.

SYNODONTIDÆ

***Synodus variegatus** (Lacepede)

A specimen 136 mm. long was secured at Penang.

CYPRINODONTIDÆ

***Lebistes reticulatus** (Peters)

Two males and a female of this West Indian fresh water fish were taken from a stream on Singapore Island, their lengths 15 to 35 mm. This fish has been carried all over the world by aquarists, so it is not surprising that this lovely creature should be naturalized in a region so similar to its native habitat in Trinidad and Venezuela. Dorsal 7 or 6; anal II–5; scales in longitudinal series 28; predorsal 12.

BELONIDÆ

***Busuanga philippina** Herre

A specimen of this peculiar Philippine species was taken at Singapore, its length 338 mm.

***Hemiramphus marginatus** (Forskal)

Two examples were taken at Penang, their lengths 155 and 167 mm.

Zenarchopterus brevirostris Günther

(*Zenarchopterus dispar* Peters).

A specimen 82 mm. long was taken at Singapore.

The genus *Zenarchopterus* is one of much difficulty, and as Fowler's list has omitted reference to the important papers by Erna Mohr, and her new species from Malaya, a key is here presented to help distinguish the species thus far recorded. This key is based on the characters of adult males.

Key to the species of Zenarchopterus known from Malaya

A.—Two dark brown circular spots on each side of middle of body, above the silver stripe from pectoral to caudal — *Z. quadrimaculatus* Mohr

Only known from the Muar River, Selangor.

AA.—Not spotted as above.

B.—Dorsal not modified.

C.—Anal with 8 or 9 rays, in 2 parts; 5 rays in first part, the third ray longest; the slender first ray of the second part longest .. — *Z. beauforti* Mohr

From the Muar River, Selangor.

CC.—Anal with 11 or 12 rays.

D.—Anal not forked or divided, the 6th and 7th rays enlarged and

thickened, but not reaching caudal base; occurring generally from Singapore to Penang .. .. *Z. buffoni* (Cuv. & Val.)

DD.—Anal forked, the 6th ray broadest, longest, and forked; the 7th and 8th also elongate, the others normal; a sheath of skin forms a pocket at base of 8th ray and veils base of last rays. Known only from Bangkok and Penang .. *Z. pappenheimi* Mohr

BB.—Some of the dorsal rays more or less modified; anal rays 11 to 13.

E.—Triangular part of upper jaw nearly twice as long as broad; 3rd to 6th dorsal rays strongly elongate but not much thickened; 5th, 6th, and 7th anal rays much thickened and elongated Muar River, Selangor, and Singapore; also widely distributed elsewhere .. *Z. amblyurus* Bleeker

EE.—Triangular part of upper jaw broader than long; 5th dorsal ray thickened and elongate; anal in 3 parts, the first 5 rays normal; 6th ray very wide and thick, feathered behind and covered with thick skin, extending far upon the caudal; 7th ray long and thick, with a basal pocket covering also the bases of the 8th and 9th rays. Singapore; from the Carolines and Fiji to Madagascar and Mozambique .. *Z. brevirostris* Günther

MUGILIDÆ

***Mugil longimanus** Gunther

Fifteen specimens, 55 to 11 mm. in length, were collected at Penang.

***Liza caeruleo-maculatus** (Lacepede)

Three specimens, 123 to 126 mm. in length, from Singapore, and one of 160 mm. from Sandakan, British North Borneo.

SYNGNATHIDÆ

***Corythoichthys fasciatus** (Gray)

Two examples, 85 to 99 mm. in length, from a brook on Singapore Island.

***Doryichthys martensi** (Peters)

Common in streams of rolling country of southern Johore. Fourteen specimens 52 to 96 mm. in length, were taken in the Mawai District, Johore, and 4 from 75 to 95 mm. from a brook 5 miles north of Kota Tinggi.

The snout is shorter than the rest of the head; dorsal 31–36; trunk rings 15 or 16; caudal rings 33 to 36; 1 or 2 trunk rings under the dorsal and 5 to 7 tail rings. There is a black spot on the hind margin of each ring along the median line of each side, from the fourth to the next to the last trunk ring. Males have a black band from the tip of the snout through the eye to the pectoral base, and a black stripe from the tip of the chin on the under side of the head to below the hind margin of the eye. The lower half of the opercle is barred or spotted with black.

***Syngnathus fasciolatus** Dumeril

A specimen 82 mm. long from Singapore. Previously known only from Java.

Trachyrhamphus serratus (Schelegel)

A specimen 135 mm. long, from a Singapore reef, is the second record from there.

SCOMBRIDÆ

***Neothunnus rarus** (Kishinouye)

A specimen 400 mm. long was found in the Singapore market. Dorsal XIII–14–VIII; anal XIII–VIII. Gill rakers 6 plus 17; scales about 215. The pectoral reaches to the last dorsal spine.

CARANGIDÆ

Selaroides leptolepis (Cuv. and Val.)

Six specimens, 86 to 130 mm. in length, from the market at Johore Bahru. The color in life is silvery, with a golden stripe from the snout to the caudal base, and a large black spot on the shoulder; the dorsal is largely golden, its upper portion black.

***Elagatis bipinnulatus** (Quoy and Gaimard)

A specimen 295 mm. long, from Singapore.

ANABANTIDÆ

The Genus **Betta**

Various species of this genus have become widely distributed by aquarists, and names have been very loosely applied by aquarists. The nomenclature is an a sad state of confusion, and old records made before Regan's revision are scarcely to be relied upon. Many later records are also dubious. For example, *Betta pugnax* Cantor has been reported from numerous localities in Borneo, Sumatra, and the Malay Peninsula, but the only locality where it is definitely known to occur is at Penang. I have thus far failed to find *B. pugnax* anywhere except on Penang island.

Weber and De Beaufort call attention to the variability of the characters, which seem scarcely fixed as yet, and vary widely according to sex, age, and locality. A number of species are known only from a single specimen; no doubt some of these are valid, but observance of large number of living specimens in their native habitat, and comparisons of them after two or more years in preservative, have shown that few markings are serviceable in distinguishing species. Some very diverse kinds appear almost identical after a year or more in alcohol, losing their brilliant markings and developing one or two longitudinal black stripes on a brown background, so that they all seem mere variants of a single species. It is altogether probable that a revision based upon a very large amount of material from all over Malaya, Borneo, Sumatra, and Siam, would show that several of the species now accepted should be relegated to synonymy.

Key to the species of Betta

A.—All dorsal and anal rays articulated, without spines
  B.—Maxillary extending beyond middle of eye; a large black ocellus on dorsal — 1. *B. macrostoma*
  BB.—Maxillary not going beyond front margin of eye; no ocellus on dorsal; a blackish spot at caudal base .. .. .. — 2. *B. unimaculata*

AA.—Anal with 1 to 4 spines
  C.—Dorsal rays flexible and articulated, without spines ..
    D.—Maxillary reaching below nostrils or front margin of eye; dorsal origin halfway between head and caudal, or nearer the latter.

E.—Anal II–20–24; dorsal over 14th to 16th scale; predorsal scales 20–26; interorbital 2·4–2·9 in head; uniform brown .. .. 3. *B. fusca*

EE.—Anal I or II–25 to 30.

F.—Anal I–27; dorsal origin over 16th or 17th scale; predorsal scales about 30; interorbital more than 3 in head; brownish with a dark stripe along each row of scales .. 4. *B. akarensis*

FF.—Anal II–25–30; dorsal origin over 17th or 18th scale; predorsal scales 26–30; interorbital about 2·5 in head; brown with dark lines on transverse rows of scales .. 5. *B. anabatoides*

DD.—Maxillary reaching beyond front margin of eye.

G.—Caudal base with distinct ocellus; maxillary to below front part of pupil .. 6. *B. ocellata*

GG.—No ocellus on caudal base; maxillary to front border of eye or a little more .. 7. *B. patoti*

CC.—Dorsal with 1 or 2 small sharp spines

H.—Dorsal with 2 spines

I.—Dorsal II–8 or 9, the spines stout; anal II–23–25; lateral scales 29–30; predorsal 23–25; transverse 11 .. .. 8. *B. brederi*

II.—Dorsal II–7, spines very slender, weak; anal III–26; lateral scales 31, predorsal 27, transverse 10 9. *B. balunga*

HH.—Dorsal with but 1 more or less pungent spine

J.—Predorsal scales 20–24; anal I or II–19–23; lateral scales 28–30; Dorsal I–6–8; 3 black longitudinal bands .. .. 10. *B. picta*

JJ.—Predorsal scales 25 or more
K.—Sides with vertical cross bars
L.—Anal III–21; dorsal 1–7; lateral scales 30, predorsal 28; 5 or 6 dark vertical cross bars on pale ground color; dorsal origin above 16th scale .. 11. *B. rubra*
LL.—Anal II–28–30; Dorsal I–9–10; lateral scales 34–36, predorsal 28–30; dorsal origin above 18th or 19th scale; 6 to 10 dark brown cross bars on brown ground color 13. *B. fasciata*
KK.—No vertical cross bars
M.—Anal II–IV–21 to 24; dorsal I–8–9; lateral scales 30–32, predorsal 27; anal very deep and elongate posteriorly; life colors brilliant red, blue, green, black .. 14. *B. splendens*
MM.—Anal spines I or II
N.—28–32 scales in lateral series; depth 3·3 to 4
O.—Longitudinal band from snout over eye and one below pectoral, uniting at caudal base, usually in a circular spot; lateral scales 28–31; predorsal 25–26; anal II–20 to 25 .. 15. *B. taeniata*
OO.—Without 2 bands as above; no longitudinal lines on scale rows; a dark stripe from snout over eye across head; anal II–25–26; lateral

scales 30–32, predorsal 26 or 25; dorsal I–7 or 8 ..	16. *B. pugnax*
NN.—35 scales in lateral series; predorsal about 30; anal II–30–34; dorsal I–10; depth 4·2 in length ..	17. *B. bellica*

Betta ocellata de Beaufort, Bull. Raffles Museum, No. 8, p. 35, December, 1933.

Dorsal 8 or 9, without spines, the first ray very short; anal II–29 or 30, or I–30; scales in longitudinal series 33 to 35, plus 4 very small ones on caudal base; predorsal scales 26 to 29; transverse series 9½. Dorsal origin opposite 19th or 20th scale.

Depth 4· to 4·3, head 2·8 to 3, caudal 3 times in the length; the eye is 4·4 to 4·6 times in the head, 2·5 in the post-ocular portion, and 1·6 in the interorbital; snout 4·2 interorbital 2·75 to 2·85, and least depth of caudal peduncle 1·8 to 2·1 times in the head. The head is broad, the posterior half of the trunk greatly compressed, the caudal fin very broad and rounded, with the central rays sometimes prolonged a little. The ventrals are long, with filiform tip, usually as long as the head without the snout, rarely as long as the entire head.

The color is pale to dark brown, with a black ocellated spot a little below the centre of the caudal base; in young or medium sized specimens there may be a black stripe from the tip of the snout to the caudal peduncle, stopping before reaching the ocellus; young specimens may show a second stripe from beneath the pectoral and along the upper side of the abdomen, curving upward to join the upper band before the ocellus; the opercles, top of the head, snout, and lower jaw may be very dark or nearly black. The caudal is cross barred by numerous alternating rows of dark brown and very pale brown spots, or sometimes is uniform brown; the pectorals are nearly colorless, with a pale or whitish bar across the base in larger specimens; the other fins are all brown; sometimes the dorsal and anal may have a few darker spots.

Dr. de Beaufort had but one specimen, 91 mm. long, from Bettotan, British North Borneo. I have seen none so large. I collected 2 specimens, 35 and 70 mm. in length, from the Balung River, about 45 miles north of Tawau, British North Borneo; 3 examples, 21 to 26 mm. long, from the Kinabutan River, near Tawau; 9 specimens 20 to 65 mm. in length from the Kabili River, a tributary of Sandakan Bay, British North Borneo. Through the co-operation of H. G. Keith, conservator of forests of British North Borneo, the following were received:—3 from

28 to 60 mm. long, from the Gum Gum River; 3 from 62 to 77 mm. long from the Mapat River, near Semporna; and 2 specimens, 55 and 65 mm. in length, from the type locality, the Bettotan River, near the head of Sandakan Bay.

Betta balunga Herre, new species

Dorsal II–7, the pungent spines delicate; anal III–26; pectoral 12; caudal 13; 31 scales in a longitudinal series, plus 2 on the caudal base, and many very small ones running far out on the caudal rays; predorsal scales 27; transverse series 10.

The dorsal profile is convex, the arc broken under the dorsal, and greatly flattened to the caudal; the ventral profile is gently and uniformly arched. Depth 3·4, head 2·8, caudal 2·55 times in the length; the eye and snout are equal, 3·6 times in the head and twice in the postorbital; the interorbital is 3 times in the head; least depth of caudal peduncle 5·35 times in the length, about 1·9 in the head; the maxillary does not quite reach a vertical from the front margin of the pupil. The dorsal origin is opposite the 17th scale of the lateral series, and midway between the head and the caudal base; the fifth dorsal ray is twice in the head; the twenty-third anal ray is longer than the head, 2·3 in the length; the pectoral is 1·5 in the head, 4·25 in the length; the thread-like first ventral ray is 1·2 in the head, 3·4 times in the length; the anal has a low basal sheath of one series of scales, the second and third penultimate rays elongate and reaching more than half the caudal length.

The color in alcohol is pale brown, with a darker band from the eye to the caudal base, and a second indistinct band from under the pectoral to above the posterior end of the anal; a faint stripe extends from the upper part of the caudal base to the angle of the opercle, where it becomes a blackish band extending to the eye and crosses behind the eye to join its fellow; a blackish band descends from the eye diagonally forward to the under side of the head; the unmarked fins are brownish.

The type and sole specimen, 51 mm. was taken from a tiny brook tributary to the Balung River, 45 miles from Tawau, British North Borneo. From *Betta taeniata* Regan, to which it is most closely related, it differs in having 2 dorsal spines, instead of one, in the position of the dorsal, and in having 3 anal spines.

Betta picta (Cuv. and Val.)

Dorsal I–8 or II–7 or 8; anal II–23 or I–II–III–22–24; scales 28–29; predorsal scales 22–24; transverse scales 9½–10½.

Specimens were collected as follows:—5 from 51 to 55 mm. in length, from a creek on the Mandai Road, Singapore Island; 105 from 15 to 70 mm. in length from a mountain stream flowing into Gunong Pulai Reservoir, Johore; 15 from 34 to 57 mm. from a mountain brook 14¾ miles north-east of Kuala Lumpur,

and 7 from 31 to 59 mm. from another mountain brook on the west side of Ginting Sempak, Selangor; 1 of 35 mm. from a brook 16 miles east of Kuching, Sarawak, Borneo.

The color is paler to darker brown, with 3 dark longitudinal stripes, the middle one from the snout over the eye to the caudal base; the upper one begins on the opercle and runs to the caudal peduncle; the lower one starts under the pectorals and continues back to the caudal peduncle or caudal base; often a black band runs from eye to eye under the head. In some of our specimens, particularly those from mountain streams, melanism is very marked on the head and sides to the level of the pectoral.

Betta taeniata Regan

Dorsal I–7–8; anal II–22–26; scales 28–31; predorsal scales 23–24, to 25 or 26; transverse series 10.

Specimens were collected as follows:—From the Botanic Garden, Singapore, 12 from 34 to 56 mm. in length; 50 from 25 to 56 mm., from the Mandai Road, Singapore. From Johore 33 taken in the Mawai District, 34 from a stream 5 miles north of Kota Tinggi and 12 from one 8 miles north of Kota Tinggi, and 4 from Gunong Pulai, their lengths 20 to 62 mm.; One from Ulu Jelai, Pahang, 48 mm. long; 13 from 23 to 49 mm. from a brook 2 miles north of Sauk, Perak; and 5 from a stream 16 or 18 miles east of Kuching, Sarawak, Borneo, their lengths 17 to 31 mm.

Some of the specimens from hill streams were very brilliant in life and for a long time were labelled as a new species but were finally placed here. Each scale is marked by an emerald spot and there is a large emerald spot on the opercle, with a green stripe along the lower margin of the opercle. There is a black stripe from the tip of the snout across the eye to the hind end of the head. In alcohol the green on the head becomes black, while that on the scales disappears very quickly. These specimens are intermediate between *Betta picta* and *Betta taeniata*, and do not really fit very well anywhere.

***Betta rubra** Perugia

I refer here a small specimen, 32 mm. long, collected on Singapore Island. The depth is 3·2, the head 3·5 times in the length. The least depth of the caudal peduncle is a little greater than the postorbital part of the head, and is 1·5 times in the head. Dorsal I–7; anal II–21; scales in longitudinal series 30; predorsal scales 28. The dorsal origin is opposite the 16th lateral scale, and a little nearer to the caudal base than to the head. The anal fin has a basal sheath of one row of scales anteriorly, and with some small additional scales above posteriorly. The color is reddish brown, with 5 or 6 dark vertical cross bars.

This Sumatran species may be native, but is possibly an escape from cultivation.

*Betta splendens Regan

Two examples, 33 and 37 mm. in length, were taken from a brook on the Mandai Road, Singapore Island. This lovely Siamese fish has been kept in captivity at Singapore for at least a century, having been seen there by Cantor more than 90 years ago. It is not surprising that it should have become established in Singapore streams in that time.

Betta anabatoides Bleeker

Seven specimens, 32 to 72 mm. in length, from Singapore, and 2 examples 43 and 48 mm. in length from a stream 5 miles north of Kota Tinggi, Johore.

Dorsal 8 to 10, without spines; anal II–25–30; scales 30 to 34. Color in life brown, with green opercles and green points on the scales, the green disappearing or turning black in alcohol. With age the middle caudal rays are prolonged, and the dorsal and anal become elongated, the latter even reaching almost to the end of the caudal. Body marked with transverse dark lines; under side of head more or less black.

Betta fusca Regan

Dorsal 6 or 7 (8 or 9 according to Regan and Weber & de Beaufort); anal II–20–24; scales in longitudinal series 29–32 (in one specimen only 26); some examples have a well defined lateral line, with a pit on each scale; predorsal scales 24–27 (22–26 in Weber and de Beaufort).

The depth is 3.5, the head 3 times in the length; the eye is 4, the snout 5·1, the interorbital 2·5, the postorbital 1·8, the least depth of the caudal peduncle 1·9 times in the head. The eye is 1·5 times in the interorbital and 2·22 in the postorbital. The maxillary extends to below the posterior nostril. The dorsal origin is opposite the 16th scale.

Specimens were collected as follows:—1 of 46 mm. from the Mandai Road, Singapore; 1 of 42 mm. 5 miles north of Kota Tinggi and 6 from 33 to 56 mm. from the Mawai District, Johore; one of 48 mm. from 18 miles east of Kuching, Sarawak, Borneo.

SERRANIDÆ

*Epinephelus flavocaeruleus (Lacepede)

A fine specimen 410 mm. long was taken at Singapore.

PLESIOPIDÆ

*Plesiops melas Bleeker

Two specimens from Pulau Tioman are 48 and 50 mm. in length.

PEMPHERIDÆ

***Pempheris itoi** Fowler

A specimen of this rare East Indian fish was taken at Singapore, its length 125 mm. There are 67 or 68 scales in the lateral line, plus 20 or 21 on the caudal; 9 or 8½ scales above the lateral line; 6+18 gill rakers on the first gill arch.

POMADASYIDÆ

***Cæsio pisang** Bleeker

A specimen 90 mm. long was secured at Singapore.

***Cæsio xanthonotus** Bleeker

Four specimens, 115 to 153 mm. in length, were purchased at the Singapore market.

Scolopsis tæniopterus Cuv. and Val.

A specimen 250 mm. long, from Singapore. Omitted from Fowler's list, but recorded by Weber and de Beaufort from Singapore and the East Coast of Malaya, in Fishes Indo-Australian Archipelago, vol. VII, p. 325, 1936.

Haplogenys mucronatus (Schlegel)

A specimen 196 mm. long, from Sandakan, British North Borneo; new to Borneo.

Dorsal XI–16; anal III–9.

LETHRINIDÆ

***Lethrinus hypselopterus** Bleeker

A specimen 110 mm. long, from the Singapore market.

***Lethrinus leutjanus** Bleeker

A specimen 183 mm. long, from Singapore.

MULLIDÆ

***Parupeneus malabaricus** (Cuv. and Val.)

One example, 244 mm. long, from Singapore.

SCIÆNIDÆ

Johnius coibor (Buch. Ham.)

Two specimens, 169 and 184 mm. in length, were taken at Tawau, British North Borneo. Dorsal X–I–28; anal II–7; scales in lateral line 51; gill rakers 5+9 on first gill arch.

The depth is 3·1 to 3·2, the head 3·2 to 3·45 times in the length; the eye is 4·85 to 5 times in the head. The anal origin is opposite the 12th dorsal ray, its base 4·4 to 4·5 times in the base of the soft dorsal. The opercle has two flat weak spines. The first anal spine is short and stout, not minute. A large black diffuse blotch on the opercle. The first dorsal is black, the soft with a black margin, its lower half white, with a black spot at the base of each ray.

***Johnius goldmanni** (Bleeker)

Two specimens, 114 and 118 mm. in length, from Singapore. Dorsal X–I–27; anal II–8; lateral line scales 50 or 51; gill rakers 6+11. The depth is 3·1 to 3·2, the head 2·8 times in the length; the eye is 3·85 to 4·1 in the head and 1·2 to 1·3 times in the length of the anal spine; the upper lip has a median pore.

CHÆTODONTIDÆ

***Chætodon fasciatus** Forskal

A specimen 175 mm. in length was taken at Singapore.

ACANTHURIDÆ

***Acanthurus olivaceus** (Bl. and Schn.)

A Singapore specimen measures 225 mm.

***Naso lituratus** (Forster)

Two specimens, 206 and 216 mm. in length, were collected on Singapore reefs.

SIGANIDÆ

***Lo vulpinus** (Schlegel and Müller)

Two specimens, 158 and 162 mm. in length, from the Singapore market.

***Teuthis striolata** Gunther

A specimen 122 mm. long, from the Singapore market.

SCORPÆNIDÆ

***Trichopleura mollis** (Richardson)

(*Stethopus mollis* Richardson, Voy. Samarang, Fishes, p. 10, plate 2, figs. 6 and 7, 1848).

A specimen of this rare little fish, 42 mm. long, was taken on a Singapore reef. Dorsal III–I–VIII–8; anal III–6; ventral I–2. The head and body are sparsely sprinkled with minute filaments. The first 3 dorsal spines form a separate division of the dorsal fin; the next spine is intermediate in distance between the first group and the main group of dorsal spines.

***Vespicula trachinoides** (Cuv. and Val.)

A specimen 26 mm. long was secured in the brackish water of the mangrove mud flat drained by the Kranji River, Singapore Island.

***Vespicula leucogaster** (Richardson)

Five examples, 32 to 67 mm. in length, were taken from a reef in the outer harbor of Singapore.

PLATYCEPHALIDÆ

Platycephalus malayanus Bleeker

Four specimens, 103 to 131 mm. in length, were collected at Sandakan, British North Borneo. Dorsal I–VII–10 or 11; anal 11 or 12; the first ray of both dorsal and anal is simple.

***Sorsogona serrulata** Herre, Fishes of the Herre 1931 Philippine Expedition, p. 67, 1934.

A specimen of this rare species was taken on a Singapore reef, its length 64 mm. Previously known only from the type, 70 mm. long, taken on the coast of Sorsogon Province, Luzon, P.I. Dorsal I–VIII–11; anal 11. This specimen agrees in detail with the type, except that it is broader and deeper, with a larger head. The head is 2·7, the depth 5·8 times in the length. The eye is 4, the snout 3 and a third times in the head.

Elates ransonnetti (Steindachner)

Platycephalus ransonnetti Steindachner, Akad. Wiss. Wien. Sitsungbs, vol. 74, part 1, p. 209, 1876.

Elates thompsoni Jordan and Seale, Fishes of the Islands of Luzon and Panay, Bull. Bur. Fisheries, vol. 26, p. 39, Jan. 11, 1907.

A specimen 136 mm. long was taken from a reef in the outer harbor of Singapore, apparently the first taken in Malaya since Baron Ransonneti collected it for Steindachner. It is not very rare in Manila Bay, where it is taken by the trawl fishermen.

POMACENTRIDÆ

***Chromis dimidiatus** (Klunzinger)

Three examples, 38 to 44 mm. in length, from a Singapore reef.

***Abudefduf aureus** (Cuv. and Val.)

A specimen 97 mm. long was collected at Singapore.

LABRIDÆ

***Cheilinus oxycephalus** Bleeker

A specimen 124 mm. long was taken from a Singapore reef.

SCARIDÆ

***Scarus forsteri** Cuv. and Val.

A specimen 222 mm. long was bought in the Johore fish market, and one of 230 mm. in the Singapore market.

ELEOTRIDÆ

***Odonteleotris canina** Bleeker

Dorsal VI–1–9; anal I–8; scales in longitudinal series 69 plus 6 on the caudal base; if counted in a straight line from opercular angle to caudal base there are 77; transverse scales 22, predorsal 42.

Bleeker evidently included the caudal in his measurements. The depth in the standard length is 4·5, with caudal 5·5 times; the head is 3·4 times or about 4 with the caudal. The snout is 4 times in the head, the eyes dorsal in position, 5 times, and 1·5 times in the flat interorbital; the large mouth is nearly vertical, reaching a vertical from the anterior part of the eye; two conspicuous canines at the front of the upper jaw and 4 in the lower jaw. The snout and interorbital are criss-crossed by numerous transverse and longitudinal sensory ridges; 6 ridges radiate from the eye upon the cheek, which also has 2 longitudinal and several transverse ridges; additional ridges are above and on the opercle; large pores on the interorbital, behind the eye, on the margin of the preopercle and in the supra-opercular groove. The short rounded caudal equals the depth; the vertical fins are low, the first dorsal 2·5, the second dorsal and anal 2·3 times in the head, the two last much short of the caudal when depressed; the pectoral is 1·4 times in the head, the ventrals 1·5, the latter not reaching the anus; the anal papilla is thin, flat, triangular.

The color in alcohol is uniform dusky brown, paler on the throat and belly; the caudal is brown, the anal a paler brown, the second dorsal pale brown with 3 or 4 transverse rows of dusky dots; the other fins are nearly colorless, but tinged with brown.

A male specimen, 72 mm. long, collected at Singapore.

A rare fish, apparently only known from 3 specimens, 45 to 63 mm. long, obtained by Bleeker from Java and the west coast of Madura.

Oxyeleotris marmorata (Bleeker)

Three specimens from streams on Singapore Island, 131 to 187 mm. in length, and 22 from streams flowing into the lake at Chenderoh Dam, Perak, their lengths 13 to 67 mm.

Dorsal VI–I–10; anal I–7; the largest specimen had the depth 4, the head 2·55, the broadly rounded caudal 3·5 times in the length. The small eye 9·1 times in the head, 2·5 in the interorbital; the postorbital portion of the head equals the depth; least depth of the caudal peduncle about twice in the head. The outer row of teeth in the lower jaw are enlarged, recurved, conical and pointed; behind are 2 or 3 rows which are reduced to a single row along the sides; the teeth of the outer row above are half the size of those in the outer row below; behind are 6 rows of minute teeth. Gill rakers 4+7 or 8 on the first arch.

Young specimens are attractive aquarium fish. Previous Malayan records are Kuala Semantan and Lake Chin Chin.

Oxyeleotris urophthalmus Bleeker

A specimen 99 mm. long was taken from the Kranji River, Singapore. Dorsal VI–I–9; anal I–8; scales in longitudinal series 85, in transverse series 25; predorsal scales 56. Previously recorded by Mr. Tweedie from Bukit Merah, Perak.

Six living examples of this little known eleotrid were bought in the market at Kuching, Sarawak, Borneo, their lengths 102 to 142 mm. A juvenile specimen, 29 mm. long was taken from a ditch 15 miles east of Kuching. Dorsal VI–I–8; anal I–8; scales 64. Evidently the number of scales increases markedly as the fish increases in size.

GOBIIDÆ

Creisson validus Jordan and Seale

Six specimens, 44 to 76 mm. in length, were taken from the Kranji River, Singapore. Previously collected by me in 1934 on a reef in Singapore harbor.

***Ctenogobius decoratus** Herre

A specimen 30 mm. long from Singapore. Originally described from Leyte, Philippine Islands; since then I have taken it at Culion, P.I., and Fiji.

***Cryptocentrus fontanesii** (Bleeker)

Five typical examples, 74 to 138 mm. in length, from a reef near Singapore.

***Gobiodon fulvus** Herre

Three specimens, 28 to 30 mm. in length, from a Singapore reef.

Ctenotrypauchen microcephalus (Bleeker)

Two examples of this rare fish, 72 to 92 mm. in length, were taken from brackish water in the Kranji River, Singapore. Obtained once before at Singapore, in 1881.

CALLIONYMIDÆ

***Synchiropus ocellatus** (Pallas)

Two specimens, each 50 mm. long, were taken from a Singapore reef.

SALARIIDÆ

***Trypterigium fasciatus** M. Weber

Three specimens, 23 to 24 mm. in length, from a Singapore reef.

Dorsal III–XII–11; anal 18; pectoral with 7 unbranched and 8 or 9 branched rays; scales 30 to 32, plus 1 on the caudal base; 14 to 16 scales in the lateral line; 2 rows below the last scales of the lateral line begins a row of 16 to 18 scales, each with a

small semicircular pit on its posterior margin, extending back to the caudal base; the number of scales with tubules and pits may be different on the two sides of the same fish.

*Petroscirtes grammistes (Cuv. and Val.)

A specimen 54 mm. long from a reef in Singapore harbor.

Dorsal 30; anal 18.

*Petroscirtes heyligeri Bleeker

A specimen 29 mm. long was caught on a reef in the outer harbor of Singapore.

Dorsal 28; anal I–19; the depth is 5·8 the head 4·3, the caudal 6 times in the length; the eye is 3·4 times in the head, the eyes close together, the interorbital width half an eye diameter. The blunt snout is nearly vertical. The canines in the lower jaw are small, those of the upper jaw still smaller. The low dorsal begins above the gill opening and ends before the caudal.

The color in alcohol is brown, with 7 dark brown double cross-bars over the back and down the sides, and extending upon the lower half of the dorsal and anal; behind the eye is a black circular dot; the head is barred with paler below the eye and on its under side; a white line runs from eye to eye; on the caudal base are 2 dark brown spots.

*Salarias dussumieri Cuv. and Val.

Three specimens, 72 to 115 mm. in length, and 2 juvenile examples, 45 and 54 mm. in length, from Singapore.

Dorsal XIII–20 or 21; anal 22, or I–21 or 22. Males with a well developed crest; the fringed orbital tentacle equals the eye; the fringed nasal tentacle is short; no canines; the dorsal extends upon the caudal.

The first dorsal is horizontally banded or spotted; the first 3 or 4 rays of the second dorsal are horizontally banded, the rest obliquely, or all are obliquely banded alternately light and dark; the anal has a broad black margin, the tips of its rays black; the caudal is spotted or barred posteriorly and above.

*Salarias guttatus Cuv. and Val.

Two specimens, 40 and 62 mm. in length, from Singapore.

Dorsal XII–17; anal 19; the eye, nape, and nostril each with a small simple tentacle.

On either side of the throat is a dark purplish ring; the sides of the head, the pectoral base, and the lower half of the side are covered with white spots; the sides are sparingly sprinkled with black dots.

BOTHIDÆ

***Pseudorhombus dupliciocellatus** Regan

Three specimens, 178 to 198 mm. in length, from the east coast of Johore.

SOLEIDÆ

***Solea heterorhina** Bleeker

Six specimens, 61 to 79 mm. in length, were purchased in the Penang market.

CYNOGLOSSIDÆ

Cynoglossus borneensis (Bleeker)

Three specimens, 196 to 229 mm. in length, from the Penang market.

Two lateral lines on the colored and 1 on the blind side; 19 or 20 scales between the lines on the colored side. Dorsal 116–118; anal 88; lateral line scales 108. Previously reported by me from Singapore and the coasts of Selangor and Perak.

***Cynoglossus monopus** (Bleeker)

Twenty-eight specimens, 93 to 130 mm. in length, from Penang.

Cynoglossus puncticeps (Richardson)

Abundant at Penang, where 42 examples, 80 to 141 mm. in length, were secured.

Cynoglossus sumatranus (Bleeker)

Five specimens, 70 to 110 mm. in length, from Penang.

BATRACHOIDIDÆ

Coryzichthys gangene (Buch. Ham.)

Two specimens from a Singapore reef are 84 and 158 mm. long, and 2 from Kuching, Sarawak, Borneo, are 127 and 138 mm. in length. Previously reported from Malaya but without definite locality.

There are 2 rows of blunt, round-tipped or bluntly conical teeth, almost molariform in shape, on the vomer and palatines.

URANOSCOPIDÆ

***Ichthyoscopus inermis** (Cuv. and Val.)

A very bulky specimen, 280 mm. long, was taken at Singapore.

MASTACEMBELIDÆ

Elongate, eel-like fishes of uncertain affinities; their appearance is very peculiar, with pointed, attenuate head and elongate snout having an appendage or prolongation at its tip. The dorsal spines are numerous, small, and sharp. When seized the fish wriggles backward, inflicting painful wounds with its

spines. The family is probably of Indian origin, now spread from south China to Malaya and the great islands contiguous, Sumatra, Java, and Borneo and westward to tropical Africa. Genera two. Some of the species reach medium to large size and are common market fish, much esteemed by the natives as food.

Key to the genera

A.—A concave appendage on the snout tip, with transverse striations on its under side .. .. .. *Macrognathus*
One species, *Macrognathus aculeatus* from India through Malaya.

AA.—Appendage on snout slender, pointed, without transverse striations beneath *Mastacembelus*

Key to Malayan species of Mastacembelus

A.—Snout naked, or only scaled on the sides
B.—Snout entirely naked no preorbital or preopercular spines .. .. *M. perakensis*
BB.—Either a preorbital spine or preopercular spines, or both are present.
C.—A preorbital spine but no preopercular spines; caudal separated from dorsal and anal by a notch *M. unicolor*
CC.—Preopercular spines present. Dorsal and anal completely united with caudal.
D.—A preorbital spine; Dorsal XXXIV to XXXIX–80 to 90; anal III–80 to 90 .. *M. armatus*
DD.—No preorbital spine; Dorsal XXXII to XXXVII–70 to 80; anal III–70 to 80 .. *M. erythrotaenia*
AA.—Snout covered with scales—a preorbital spine.
E.—Two preopercular spines; mouth not extending below nostril .. .. *M. guentheri*
EE.—No preopercular spines; mouth extending below nostril .. .. *M. maculatus*

Mastacembelus armatus (Lacepede)

Three specimens, 54 to 76 mm. long, from the Mawai district, Johore, have the dorsal XXXVIII–74; anal III–74; 3 opercular spines and 1 preorbital spine. A specimen 214 mm.

long, from Pahang, has the dorsal XXXVII–82; anal III–68; 2 opercular spines and 1 preorbital spine. The mouth extends to below the nostril, the maxillary to below the eye.

Mastacembelus erythrotænia Bleeker

A very large and bulky specimen from Chenderoh Dam, Perak, is 670 mm. long. Two examples from Kuching, Sarawak, Borneo, are 285 and 335 mm. in length.

This species is very easily recognized by the red stripes running back from the head and by the red margins to the vertical fins. The posterior half or two-thirds of the body is likewise handsomely mottled and spotted with black or reticulated with a dark network.

Mastacembelus guentheri Day

Two specimens, 47 and 59 mm. long, from the Mandai Road, Singapore, one of 131 mm. from Klang, Selangor, and one of 117 mm. from Patani, Siam.

Dorsal XXVI–58–60–68; anal III–56–58–62. A preorbital spine and 2 preopercular spines, the snout naked. The head is 5·45 times in the length, but in the little specimens is 4·6 times.

Mastacembelus maculatus Cuv. and Val.

Five specimens, 63 to 168 mm. in length, from the Mandai Road, Singapore; 2 from a hill stream 5 miles north of Kota Tinggi, Johore, their lengths 61 and 93 mm.; 5 from Pahang, 49 to 153 mm. in length; 1 of 57 mm. from Selangor; and 2 from Sarawak, Borneo, their lengths 99 and 221 mm.

Dorsal XXVII–56; anal III–60; no preopercular spine; head 6·1 in the length. Another specimen had the dorsal XXXVIII–62; anal III–60.

Mastacembelus perakensis Herre and Myers

Another example, 156 mm. in length, larger than the type, was collected in the Mawai District of Johore.

Dorsal XXXVII–60; anal II–60. There is no trace of spines, either preorbital or preopercular.

MONACANTHIDÆ

***Paramonacanthus cryptodon** Bleeker

Two examples, each 88 mm. long, from Singapore.

TETRAODONTIDÆ

Chonerhinus modestus Bleeker

Thirteen specimens, 30 to 52 mm. in length, from the Segaliud River, and 2 of 60 and 62 mm. from the Sibugal River, British North Borneo. One of 34 mm. was also taken 16 miles east of Kuching, Sarawak, Borneo.

Dorsal III–20 to 23; anal III–16 or 17.

A Bibliography of papers on Malayan fresh-water fishes

The following list includes not only papers written solely upon Malayan fresh water fishes, but many others also. An attempt has been made to include all papers describing any fresh water fishes that have thus far been collected in Malaya. This necessitates reference to most of the papers on the fresh water fishes of Sumatra, Banka, Java, Borneo, and also some of those dealing with the fishes of Indo-China, Siam, Burma, and India.

It has been impossible to obtain all of Bleeker's papers containing descriptions of Indo-Malayan fresh water fishes, so that his citations are probably incomplete, while papers by some other authors may have been overlooked. Mere lists of species have not been included. It is believed all papers of importance have been included, so that any fish not described in them may reasonably be called new.

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The fishes of the genus Pseudomonacanthus with descriptions of two new species

By A. FRASER-BRUNNER

In 1934 I received a collection of Monacanthid fishes from the Raffles Museum, Singapore, all of local provenance. Among these was a good series of a species of *Pseudomonacanthus* which appears to be new. The occasion for describing this species presented an opportunity for a revision of the genus, of which the present paper consists.

The Plectognath fishes of the family Monacanthidæ have, in the past, nearly always been divided into three great groups—those with a "movable pelvic spine", those with a "fixed pelvic spine", and those with no spine at all. The name *Pseudomonacanthus* has been used to cover the second group by more than one worker who considered these groups as representing genera.

Actually, there is no doubt that the old arrangement was artificial in many ways, and that the Monacanthidæ is comprised of a number of genera, of which *Pseudomonacanthus* is one of the smallest as defined below.

The so-called "fixed pelvic spine" is actually a dermal structure attached to the end of the pelvis, and is referred to in the descriptions which follow as the pelvic shield.

Genus PSEUDOMONACANTHUS

Pseudomonacanthus Bleeker, 1866, Ned. Tyds. Dierk. III, p. 12.

Monacanthids, with first dorsal spine originating over posterior half of eye; the spine with 4 rows of barbs; no deep groove for reception of the spine when depressed. Soft dorsal and anal fins low. Pelvic bone long, not expanded distally. Ventral flap moderately developed, especially in females. Pelvic shield small, spinate; no movable pelvic spine. Form oblong. Scales very small. Dermal filaments more or less developed. Recurved spines sometimes present on caudal peduncle.

Genotype *Monacanthus macrurus* Bleeker.

In this genus, as in most others of the family, sexual dimorphism is apparent, the females having a slightly greater depth of body, higher frontal region of the skull, more declivous profile of snout, and greater development of the ventral flap.

There are four species, apparently confined to the Indo-Australian region. The genus most nearly related appears to be the Japanese *Rudarius* which differs in the very short, deep form, and in the absence of barbs from the anterior face of the dorsal spine.

KEY TO THE SPECIES OF *Pseudomonacanthus*

I. Depth of body 2 1/3 to 2½ in the length. Middle rays of caudal fin as long as, or longer than, the head. Dorsal profile of head convex above the eye.

A. Length of dorsal spine 6¼ in length of body, the anterior barbs as large as the posterior, about 15. Length of head 3¼ in length of body. Dorsal rays 32, anal 30. Caudal fins with spots between the rays. Gill opening wider than the eye, entirely below it .. .. 1. *maynardi.*

B. Length of dorsal spine less than 6 in length of body, the anterior barbs small and numerous, the posterior ones large, about 10. Length of head 3½ to 3 5/6 in length of body. Dorsal rays 30–31; anal 27–29. Caudal fin with broad dark edge and median transverse interrupted band.

1. Interorbital width equal to diameter of eye, which is 3 in head. Gill opening wider than eye, almost entirely below it. Caudal peduncle 2¼–2½ in length of head 2. *macrurus.*
2. Interorbital width greater than diameter of eye, which is 3¼ to 3½ in head. Gill opening equal to eye, its lower end well in advance of front of orbit. Caudal peduncle 2½–3 in length of head .. 3. *tweediei.*

II. Depth of body 2⅞ in the length. Middle rays of caudal fin much shorter than the head. Dorsal profile straight above the eye. Length of dorsal spine 8 in length of body, all the barbs small, anterior ones smaller than posterior, numerous. Dorsal rays 30; anal 30. Gill opening entirely anterior to eye. Caudal peduncle 2 in length of head .. .. .. 4. *elongatus.*

The measurements given are taken as follows:—Length of body, from tip of snout (exclusive of projecting teeth) to the base of caudal fin; depth of body, from origin of soft dorsal to that of anal; length of head, from tip of snout to upper end of gill opening; caudal peduncle from base of last anal ray to base of outermost lower caudal ray; interdorsal space from immediately behind base of first dorsal spine to origin of soft dorsal.

Pseudomonacanthus maynardi. Plate XXIII, 1.

Cantherines maynardi Ogilby 1916, Proc. Roy. Soc. Queensland, XXVIII, p. 114; 1918, Mem. Queensland Mus., VI, p. 89, Pl. XXVI.

Depth of body contained 2½ times in the length, length of head 3¼ times. Interorbital space equal to diameter of eye, 4 times in length of head. Length of interdorsal space contained 4¾ times in length of body. Length of caudal peduncle contained 3 times in that of head.

Dorsal profile of snout slightly concave, becoming convex above the eye. Gill-opening wider than eye, entirely below it. Length of first dorsal spine contained 1¾ times in that of head, 6¼ times in length of body; the anterior barbs as large as the posterior, downwardly directed, thorn-like; second dorsal spine feeble, 1/3 length of first. Soft dorsal fin with 33 simple rays; anal 30. Pectoral 12. Sides with a few sparse threadlike filaments. No spines on caudal peduncle. Ventral flap moderately well developed, pelvic plate small. Caudal fin large, the middle rays 1½ times length of head.

Pale greyish-brown; sides with sparsely scattered black spots, as large as pupil. Indistinct dusky bands across snout and below soft dorsal fin; two others across chin, and a darker one at throat. Caudal fin dark, with spots at base, between the rays.

Habitat: Queensland coast; Torres Straits.

Described from a specimen 135 mm. long, collected between Arnhem Land and New Guinea, W. of Torres Straits, by Lord Moyne, now in the British Museum (Natural History).

This fish differs from the description given by Ogilby in several small particulars, but agrees very well with his figure.

This is presumably due to the fact that he described a very large example (244 mm.), but figured a different specimen. In any case there is no doubt that all represent the same species.

Judging by the sexual dimorphism seen in other species, Ogilby's figure represents a female. My specimen is a male, and the enlarged caudal fin is very likely a secondary sexual character.

Examination of two specimens received on loan from the Australian Museum appears to confirm this.

Pseudomonacanthus macrurus. Plate XXI.

Monacanthus macrurus Bleeker, 1857, Nat. Tyd. Ned. Ind., XII, p. 226; Günther, 1870, Cat. Fish Brit. Mus., VIII, p. 247.

Pseudomonacanthus macrurus Bleeker, 1865, Atlas Ichth., V, p. 134, pl. ccxxviii, Fig. 1.

Cantherines macrurus Jordan and Seale, 1905, Proc. U. S. Nat. Mus., XXVIII, p. 790; Evermann and Seale, 1906, Bull. U. S. Bur. Fish., XXVI, p. 100; Herre, 1924, Philippine Journ. Sci., XXV, no. 4, p. 458.

Depth of body contained 2 1/3 to 2½ times in the length, length of head 3½ to 3 5/6 times. Interorbital space equal to diameter of eye, 3 times in length of head. Length of interdorsal space contained 4¼ to 4½ times in length of body. Length of caudal peduncle 2¼ to 2½ in that of head.

Dorsal profile of snout concave, becoming convex above the eye. Gill opening wider than eye, the lower end but little in advance of front of orbit. Length of first dorsal spine contained 1 1/3 to 1½ times in length of head, 5¼ to 5¾ in that of body; the anterior barbs much smaller and more numerous than the posterior, narrow and downwardly directed; posterior barbs thorn-like, about 10 in number. Second dorsal spine feeble, about 1/3 length of first. Soft dorsal fin with 31 rays; anal 29. Pectoral 12. Sides with simple dermal filaments, sparsely scattered, variously developed. Ventral flap moderately developed, specially in female. Three strong antrorse curved spines on lower half of caudal peduncle in females. Caudal fin large, the middle rays as long as the head.

Brownish, with numerous small, close-set dark spots. Two or three dark bars across chin, and obscure broad bands on back below soft dorsal. Caudal fin with two dark cross-bands, the first interrupted mesially, the second bordering the fin posteriorly.

Habitat: East Indies, Philippines.

Described from three specimens 130–140 mm. long in the British Museum (Nat. Hist.). One, a female, is a paratype from Bleeker's collection. The other two, males, are from the Philippines.

A male and female are figured here in order to show the difference in shape between the sexes. It appears that in this and the succeeding species the spines on the caudal peduncle are confined to the females.

Pseudomonacanthus tweediei, sp. n. Plate XXII.

Depth of body contained 2 1/3 to 2½ times in the length; length of head 3 2/3 times. Interorbital space wider than diameter of eye, which is contained 3¼ to 3½ times in length of head. Length of interdorsal space contained 4½ to 4 2/3 times in length of body. Length of caudal peduncle 2½ to 3 times in that of head.

Dorsal profile of snout concave, becoming convex above the eye. Gill-opening equal to diameter of eye, its upper end below middle of orbit, the lower end well in advance of front margin of eye. Length of first dorsal spine contained 1½ times in length of head, 5¾ times in length of body; the anterior barbs much smaller and more numerous than the posterior, which are thorn-like, downwardly directed, about 10 in number. Second dorsal spine feeble, 1/3 length of first. Soft dorsal fin with 30–31 rays; anal 28–29. Pectoral 12. Sides with simple dermal filaments, variously developed. Ventral flap poorly developed, more so in females. Three strong antrorse curved spines on lower half of caudal peduncle in females. Caudal fin large, the middle rays as long as head.

Brownish; snout and chin with dusky transverse bars, a darker one at throat; indefinite broad cross bands from soft dorsal and anal fins across sides. Sides with numerous close-set dark spots, smaller than pupil. Margin of caudal fin with broad black band; a less distinct, interrupted band between it and base of fin.

Habitat: Singapore.

Described from five specimens 80 to 125 mm. long. In addition I have examined six others, 40 to 65 mm. in length.

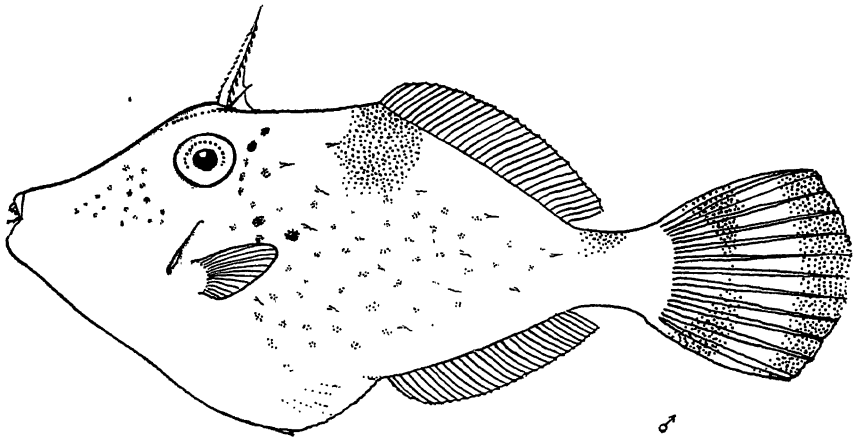
A male and female, 120 to 125 mm. long, are the type specimens, preserved in the British Museum (Natural History).

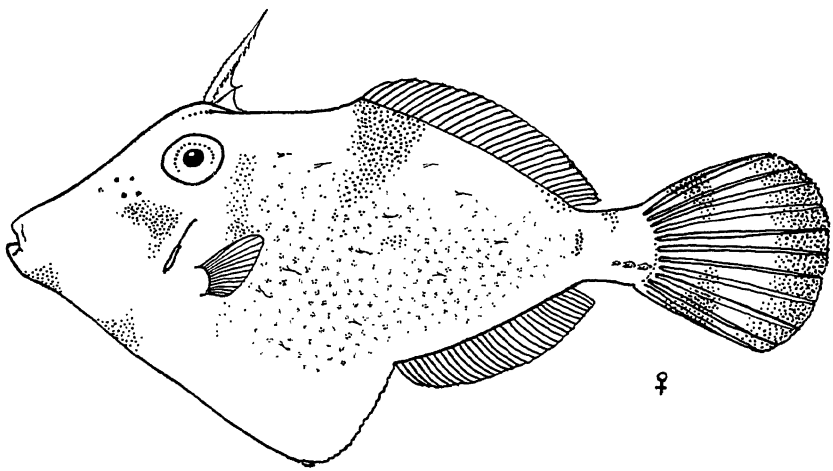
This is apparently fairly common at Singapore, since with one exception, it was the most numerously represented species in a small collection of Monacanthids sent to me by Mr. M. W. F. Tweedie, Curator of the Raffles Museum, after whom I have much pleasure in naming this fish.

It differs from *P. macrurus* in the smaller eye, wider interorbital space, shorter and more forwardly placed gill-opening, and more slender caudal peduncle. When other material is available, it may prove to be a western sub-species of *P. macrurus*.

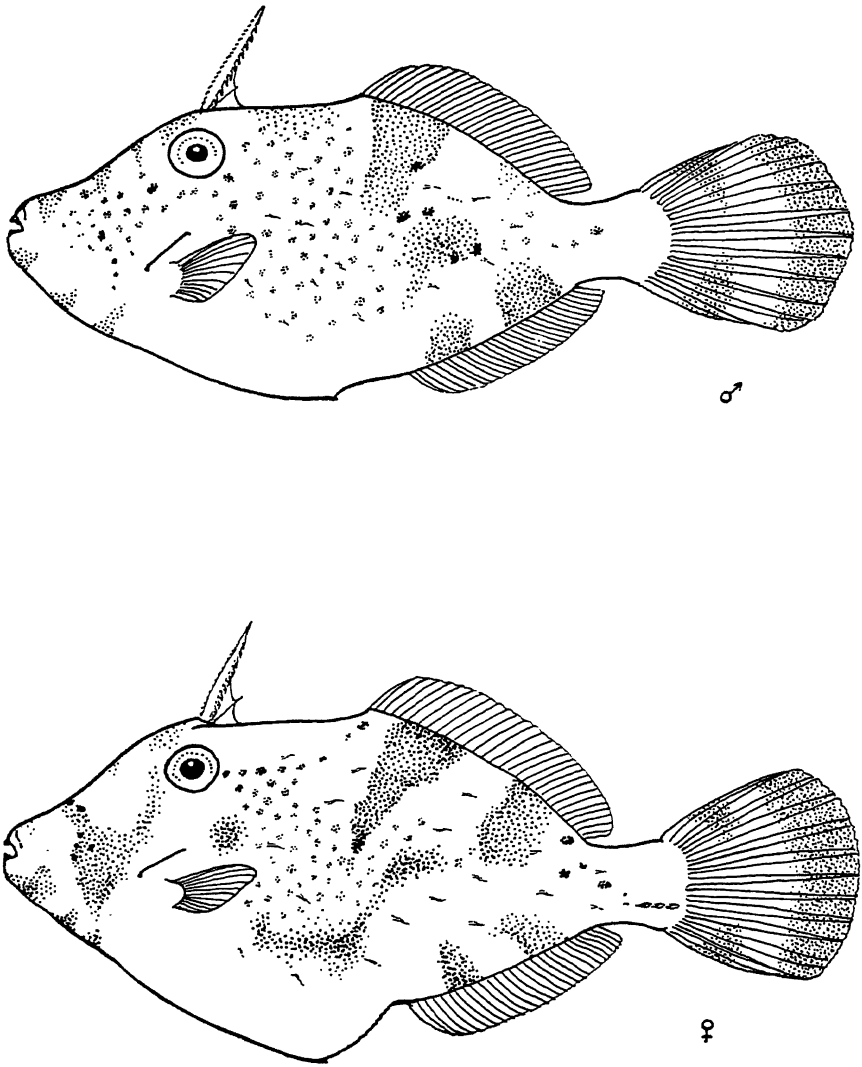
Pseudomonacanthus elongatus sp. n. Plate XXIII, 2.

Depth of body contained 2⅞ in the length; length of head four times. Diameter of eye contained four times in length of head, equal to interorbital width. Length of interdorsal space contained four times in length of body. Length of caudal peduncle half that of head.

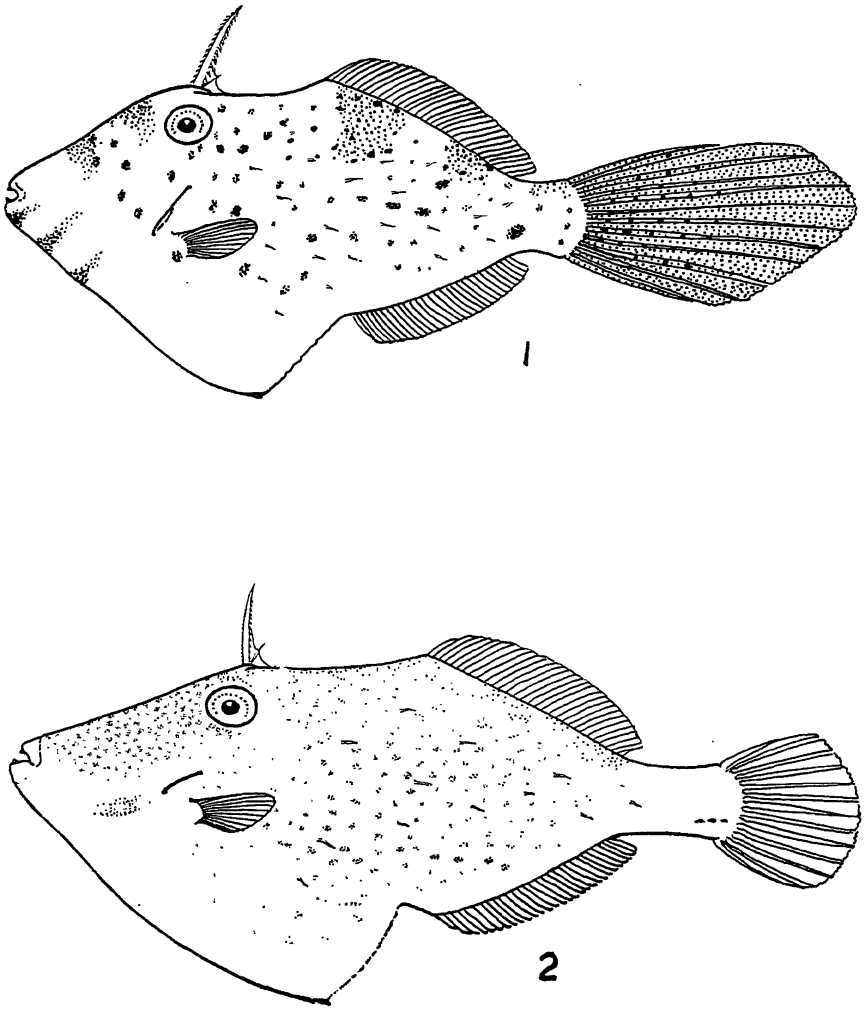




Pseudomonacanthus macrurus (Bleeker).



Pseudomonacanthus tweediei n.sp.



1. Pseudomonacanthus maynardi (Ogilby).
2. Pseudomonacanthus elongatus n.sp.

Dorsal profile straight, from tip of snout to base of first dorsal spine. Gill opening as wide as eye, entirely anterior to it. Length of first dorsal spine contained twice in that of head, eight times in that of body; all the barbs small, the anterior ones compressed and truncate, the posterior ones less numerous, slender, straight, outwardly directed. Second dorsal spine feeble. Soft dorsal fin with 30 rays; anal 30. Pectoral 12. Sides with a few small, simple dermal filaments. Ventral flap well developed. Three small blunt spines on lower half of caudal peduncle. Caudal fin small, the middle rays only half as long as head.

Pale brown; sides with numerous scattered dark spots, smaller than pupil, those on side of snout more regular, very small and close-set. Caudal fin plain.

Habitat: Tasmania (?).

Described from a single specimen, 160 mm. long, holotype of the species, collected by W. Saville Kent, and now in the British Museum (Natural History).

This fish was among a number of specimens without locality from the Saville Kent collection, many of which were, without doubt Tasmanian species, so that it seems likely that it was taken at that place.

It differs from all the preceding species in its elongate form, straight profile, the forward position of the gill-opening, and the small caudal fin. Judging by the well-developed ventral flap and the spines on the caudal peduncle, it is a female.

Additions to the collection of fishes in the Raffles Museum

By M. W. F. TWEEDIE, M.A.

A list of fishes in the collection of the Raffles Museum was compiled by the present writer some four years ago and published in the Bulletin of the Raffles Museum, 12, 1936, pp. 16–28. The identified collection consisted then of between two and three hundred species; since that time it has been more than doubled, the additional material having been identified mainly by Dr. J. D. Hardenberg and Dr. A. W. C. T. Herre. Dr. Herre visited this country in 1934 and again in 1937 and the museum benefited from both his visits; he also received and returned from America a large miscellaneous collection. Dr. J. D. Hardenberg of Batavia identified a large number of marine fishes mainly obtained from the Singapore fishmarkets. The thanks of this department are due to both these ichthyologists for the great amount of work that they have done on its behalf. A few species identified by the late Prof. Max Weber and Prof. L. F. de Beaufort, which were not incorporated in the collection when the previous list was published, are also included.

The bulk of the material listed is from two sources, the Singapore fishmarkets and the collections made by the S.S. and F.M.S. Fisheries Department at the time when the experimental trawler, S. T. "Tongkol" was operating around the Malayan coasts. Specimens in this category are all well enough localised to form useful records, but those from the fishmarkets, while the majority probably come from the neighbourhood of Singapore, may have been caught five hundred miles and more away and should not, in my opinion, be included in any list of fishes from "Malaya" where this term is intended to indicate the Malay Peninsula. The same reservation applies to the few specimens for which no data are available.

In every case the authority responsible for the identification of the specimens is indicated by his initials placed in brackets after the locality: "(J.H.)" indicates Dr. Hardenberg, "(A.H.)" Dr. Herre and "(De B.)" Prof. De Beaufort. Opinions regarding the validity of names are in every case those of the ichthyologists in question. Grouping into families was carried out by the compiler, based on the classification employed by Weber and de Beaufort and by H. W. Fowler, and the families are arranged in alphabetical order.

SHARKS AND RAYS

DASYATIDÆ

Dasyatus imbricatus (Bl. Schn.). Off Jeram, Malacca Strait, 1922, Fisheries Dept. (A.H.).

Pteroplatea micrura (Bl. Schn.). Fishmarket, Singapore. (A.H.).

Tæniura lymna (Forsk.). East coast Malay Peninsula, 1926, Fisheries Dept.; Fishmarket, Singapore. (A.H.).

DICEROBATIDÆ

Mobula kuhlii (Müller & Henle). Fishmarket, Singapore. (A.H.).

EULAMIIDÆ

Scoliodon walbeehmi (Blkr.). Fishmarket, Singapore. (A.H.).

MYLIOBATIDÆ

Aetobatus narinari (Euphrasen). Fishmarket, Singapore. (A.H.).

ORECTOLOBIDÆ

Chiloscyllium griseum Müller & Henle. Fishmarket, Singapore. (J.H.).

C. punctatum Müller & Henle. Fishmarket, Singapore. (A.H.).

PRISTIDÆ

Pristis perotteti Müller & Henle. Fishmarket, Singapore. (A.H.).

SCYLLIORHINIDÆ

Atelomycterus marmoratus (Bennett). Fishmarket, Singapore. (A.H.).

SPHYRNIDÆ

Sphyrna blochii (Cuv.). Fishmarket, Singapore. (A.H.).

S. tudes (Cuv.). Fishmarket, Singapore. (A.H.).

TORPEDINIDÆ

Narcine timlei (Bl. & Schn.). Fishmarket, Singapore. (A.H.).

Temera hardwickii Gray. Fishmarket, Singapore. (A.H.).

ACTINOPTERI (TRUE FISHES)

AKYSIDÆ

Parakysis verrucosa Herre. Mawai District, Johore. *Paratypes.*

ANABANTIDÆ

Betta picta (C.V.). West of Ginting Sempak, Selangor. (A.H.).

Osphronemus goramy Lac. River Sedili, Johore; McRitche Reservoir, Singapore. (A.H.).

Sphærichthys osphromenoides Canestrini. Kota Tinggi, Johore. (A.H.).

Trichogaster leeri (Blkr.). Ayer Hitam, Johore. (A.H.).

ANTENNARIIDÆ

Antennarius caudimaculatus Rüppell. Fishmarket, Singapore. (A.H.).

A. urophthalmus (Richardson). Fishmarket, Singapore. (A.H.).

APOGONIDÆ

Apogon orbicularis C.V. Pisang Island, Malacca Strait. (A.H.).

Apogonichthys auritus (C.V.). Sultan Shoal, near Singapore. (A.H.).

ARIIDÆ

Arius microcephalus Blkr. Fishmarket, Kuala Kangsar, Perak. (A.H.).

ATHERINIDÆ

Atherina duodecimalis C.V. Lumut, Perak, Fisheries Dept. (A.H.).

AULOSTOMATIDÆ

Fistularia petimba Lac. Siglap, Singapore. (A.H.).

BAGARIDÆ

Glyptothorax majus (Blkr.). Mawai District, Johore; West of Ginting Sempak, Selangor. (A.H.).

BAGRIDÆ

Leiocassis leiacanthus Weber & de Beaufort. Sungai Siput, Perak. (A.H.).

Mystus wycki (Blkr.). Chenderoh, Perak. (A.H.).

BALISTIDÆ

Balistapus undulatus (Mungo Park). Christmas Island, Indian Ocean. (A.H.).

BATRACHOIDIDÆ

Batrachus grunniens (Bl.). Fishmarket, Singapore. (J.H.).

BELONIDÆ

Athlennes hians (C.V.). Fishmarket, Singapore. (J.H.).

Tylosurus annulatus (C.V.). Fishmarket, Singapore. (J.H.).

T. incisus (C.V.). Fishmarket, Singapore. (J.H.).

T. leiurus (Blkr.). Fishmarket, Singapore. (J.H.).

T. punctulatus (Gthr.). Fishmarket, Singapore. (J.H.).

T. strongylurus (v. Hass.). Fishmarket, Singapore. (J.H.).

Xenentodon canciloides (Blkr.). North of Kota Tinggi, Johore. (A.H.).

BLENNIDÆ

Enneapterygius minutus (Gthr.). Aor Island, S. China Sea. (A.H.).

Salarias celebicus Blkr. Barren Island, off Sarawak. (A.H.).

S. **ceramicus** Blkr. Sembilan Islands, Malacca Strait. (A.H.).

S. **dussumieri** Val. Sembilan Islands, Malacca Strait. (A.H.).

S. **edentulus** (Bl. Schn.) Christmas Island, Indian Ocean. (A.H.).

S. **fasciatus** (Bl.). Sultan Shoal, near Singapore. (A.H.); Fishmarket, Singapore. (J.H.).

S. **lineatus** Val. Sembilan Islands, Malacca Strait. (A.H.).

S. **vermiculatus** C.V. Rumbia Island, Malacca Strait. (A.H.).

BOTHIDÆ

Grammatobothus polyophthalmus (Blkr.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

BROTULIDÆ

Dinematichthys iluocœteoides Blkr. Mentawi Islands. (A.H.).

CALLYODONTIDÆ

Callyodon balinensis (Blkr.). Fishmarket, Singapore. (J.H.).

C. **rubroviolaceus** (Blkr.). Fishmarket, Singapore. (J.H.).

CARANGIDÆ

Atropus atropus (Bl. Schn.). Fishmarket, Singapore. (J.H.).

Atule kalla (C.V.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

A. **mate** (C.V.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

Caranx (Carangoides) armatus (Forsk.). Fishmarket, Singapore. (J.H.); East coast Malay Peninsula, Fisheries Dept. (A.H.).

C. **(Selar) boops** C.V. Fishmarket, Singapore. (J.H.).

C. (S.) **crumenophthalmus** (Bl.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

C. **(Carangoides) chrysophrys** C.V. North of Aroa Islands, Malacca Strait; Johore coast. (A.H.).

C. **(C.) fulvoguttatus** (Forsk.). Fishmarket, Singapore. (J.H.).

C. **(C.) gymnostethoides** Blkr. Fishmarket, Singapore. (J.H.).

C. **(Selar) kalla** C.V. Fishmarket, Singapore. (J.H.).

C. **(Selaroides) leptolepis** C.V. Fishmarket, Singapore. (J.H.).

Chorinemus lysan (Forsk.). Fishmarket, Singapore. (J.H.).

C. tol C.V. Fishmarket, Singapore. (J.H.).

Decapterus lajang Blkr. Off Trengganu coast, Fisheries Dept. (A.H.).

D. russelli (Rüpp.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

Megalaspis cordyla (L.). Fishmarket, Singapore. (J.H.).

Seriola nigrofasciata (Rüpp.). Fishmarket, Singapore. (J.H.); Off Pangkor Island, Malacca Strait, Fisheries Dept. (A.H.).

CENTRISCIDÆ

Centriscus scutatus L. East coast Malay Peninsula, Fisheries Dept. (A.H.).

CENTROPOMIDÆ

Ambassis gymnocephalus (Lac.). Lumut, Perak. (A.H.).

Psammoperca waigensis (C.V.). Fishmarket, Singapore. (J.H.).

CEPHALACANTHIDÆ

Dactyloptera orientalis (Cuv.). East coast Malay Peninsula. (A.H.).

CEPOLIDÆ

Acanthocepola abbreviata (C.V.). Johore Strait, Fisheries Dept. (A.H.).

CHÆTODONTIDÆ

Chætodon (Chætodontops) collare Bl. Fishmarket, Singapore. (A.H.).

C. melanotus Schn. Fishmarket, Singapore. (J.H.).

Coradion chrysozonus (Cuv.). Fishmarket, Singapore. (J.H.).

Heniochus monoceros Cuv. Fishmarket, Singapore. (J.H.).

Platax batavianus C.V. Fishmarket, Singapore. (J.H.).

P. pinnatus (L.). Fishmarket, Singapore. (J.H.).

P. teira (Forsk.). Fishmarket, Singapore. (J.H.).

Zanclus cornutus (L.). Fishmarket, Singapore. (J.H.).

CLUPEIDÆ

Amblygaster leiogaster (C.V.). Malacca. (A.H.).

Chirocentrus hypselosoma Blkr. Fishmarket, Singapore. (J.H.).

Dorosoma chacunda (H.B.). Fishmarket, Singapore. (J.H.).

Hilsa macrura (Blkr.). Fishmarket, Singapore. (A.H.).

Ilisha indica (Swainson). Malacca Strait, Fisheries Dept. (A.H.).

Opisthopterus valenciennesi (Blkr.). Malacca Strait. (A.H.).

Pellona dichtoa C.V. Fishmarket, Singapore. (J.H.).

Sardinella clupeoides (Blkr.). Fishmarket, Singapore. (A.H.). Specimens described as "not typical".

S. melanura (Cuv.). Off Endau, Pahang. (A.H.).

S. (Clupea) sirm (Rüpp.). Fishmarket, Singapore. (J.H.).

Scutengraulis kammalensis (Blkr.). Off Bagan Datoh, west coast Malay Peninsula. (A.H.).

Setipinna taty (C.V.). Off Bagan Datoh, west coast Malay Peninsula. (A.H.).

Stolephorus commersoni Lac. Malacca Strait. (A.H.).

S. insularis Hardenberg. Fishmarket, Singapore. (J.H.).

S. tri (Blkr.). Kuala Bernam, west coast Malay Peninsula. (A.H.).

Thrissina bælama (Forsk.). Malacca Strait, 30 fathoms, Fisheries Dept. (A.H.).

Thryssa grayi (Blkr.). Fishmarket, Singapore. (J.H.).

COBITIDÆ

Acanthophthalmus kuhli (C.V.). Mawai District, Johore. (A.H.).

A. perakensis Herre. Chenderoh, Perak. *Paratypes.*

Lepidocephalus hasselti (C.V.). Sauk, Upper Perak. (A.H.).

L. furcatus de Beaufort. Bukit Merah Reservoir, Perak. *Paratypes.*

Nemachilus selangoricus Duncker. Singapore; Mawai District, Johore. (A.H.).

CONGRIDÆ

Muræsesox cinereus (Forsk.). Fishmarket, Singapore. (J.H.).

M. talabon (Cantor). Fishmarket, Singapore. (J.H.).

CONGROGADIDÆ

Congrogadus subducens (Rich.). Fishmarket, Singapore. (A.H.).

CYPRINIDÆ

Brachydanio albolineata (Blyth). Sauk, Upper Perak. (A.H.).

Cyclocheilichthys heteronema (Blkr.). Sauk, Upper Perak. (A.H.).

Dangila festiva (Heckel). Kota Tinggi, Johore. (A.H.).

Epalzeorhynchus siamensis. Smith, Upper Perak. (A.H.).

Lissochilus hendersoni Herre. Penang. *Paratypes.*

L. normani Smith. Cameron Highlands, Pahang; West of Ginting Sempak, Selangor. (A.H.).

L. tweediei Herre. Cameron Highlands, Pahang; West of Ginting Sempak, Selangor; West of Bukit Telaga, Selangor. (A.H.).

Macrochirichthys macrochirus (C.V.). Chenderoh, Upper Perak. (A.H.).

Osteochilus melanopleurus (Blkr.). Chenderoh, Upper Perak. (A.H.).

O. spilurus (Blkr.). Mawai District, Johore; Ayer Hitam, Johore. (A.H.).

Puntius bulu (Blkr.). Chenderoh, Upper Perak. (A.H.).

P. dunckeri Ahl. Mawai District, Johore. (A.H.).

P. everetti (Blgr.). North of Kota Tinggi, Johore. (A.H.).

P. fasciatus (Blkr.). Ayer Hitam, Johore. (A.H.); Kota Tinggi, Johore.

P. partipentazona (Fowler). Lake Chin Chin, Malacca; Sauk, Upper Perak. (A.H.).

Rasbora cephalotænia (Blkr.). Mawai District, Johore; Ayer Hitam, Johore. (A.H.).

R. elegans Volz. Mawai District, Johore; Gunong Pulai, Johore; Tranum, Pahang. (A.H.).

R. maculata Duncker. Kota Tinggi, Johore. (A.H.).

R. tæniata Ahl. Mawai District, Johore. (A.H.).

Thynnichthys thynnoides (Blkr.). Chenderoh, Upper Perak, (A.H.).

Tor tambra (C.V.). River Plus, Perak. (A.H.).

DIODONTIDÆ

Chilomycterus orbicularis (Bl.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

Diodon bleekeri Gthr. Singapore. (A.H.).

ECHENEIDÆ

Echeneis naucrates L. Singapore. (A.H.).

E. remora L. Fishmarket, Singapore. (J.H.); Rhio Archipelago. (A.H.).

ELEOTRIDÆ

Ophiocara porocephala (C.V.). Kranji, Singapore. (A.H.).

Valenciennea muralis (Q.G.). Sembilan Islands, Malacca Strait. (A.H.).

EXOCŒTIDÆ

Cypsilurus oligolepis (Blkr.). Fishmarket, Singapore. (J.H.).

GOBIIDÆ

Brachygobius xanthomelas Herre. Mawai District, Johore. *Paratypes.*

Creisson validus Jordon & Seale. Kranji, Singapore. (A.H.).

Cryptocentrus fontanesii (Blkr.). Sultan Shoal, near Singapore. (A.H.).

Ctenogobius kranjiensis Herre. Kranji, Singapore. *Paratypes.*

Glossogobius giurus (H.B.). Chenderoh, Upper Perak. (A.H.).

Gobius ornatus Rüpp. Sembilan Islands, Malacca Strait. (A.H.).

Vaimosa mawaia Herre. Kota Tinggi, Johore. (A.H.).
V. perakensis Herre. Chenderoh, Upper Perak. *Paratypes.*
V. piapensis Herre. Kranji, Singapore. (A.H.).
V. singapurensis Herre. Jurong, Singapore. *Paratypes.*
V. spilopleura H.M. Smith. Langkawi Islands. (A.H.).

HEMIRHAMPHIDÆ

Arrhamphus brevis (Seale). Fishmarket, Singapore. (J.H.).
Dermogenys orientalis (M. Web.). Mawai District, Johore. (A.H.).
Hemirhamphus gaimardi C.V. Fishmarket, Singapore. (A.H., J.H.).
H. marginatus Forsk. Fishmarket, Singapore. (J.H.).
H. melanurus C.V. Fishmarket, Singapore. (J.H.).
H. quoyi C.V. Fishmarket, Singapore. (J.H.); Port Dickson, Selangor, Fisheries Dept. (A.H.).
H. unifasciatus Ranzani. Fishmarket, Singapore. (J.H.).

HEPATIDÆ

Acanthurus aliala Lesson. Christmas Island, Indian Ocean. (A.H.).
Hepatus flavoguttatus (Kittlitz). Fishmarket, Singapore. (J.H.).
H. gahm (Gthr.). Fishmarket, Singapore. (A.H.).
H. leucosternon (Bennet). Fishmarket, Singapore. (J.H.).
H. lineatus (L.). Fishmarket, Singapore. (J.H.).
H. mata (Cuv.). Fishmarket, Singapore. (J.H.).
Naso lituratus (Bl. Schn.). Fishmarket, Singapore. (A.H.).
N. unicornis (Forsk.). Fishmarket, Singapore. (J.H.).

HOMALOPTERIDÆ

Homaloptera tweediei Herre. Mawai District, Johore. *Paratypes.*

LABRIDÆ

Cheilinus diagrammus (Lac.). Fishmarket, Singapore. (J.H.).
C. fasciatus (Bl.). Fishmarket, Singapore. (J.H.).
Cheilio inermis (Forsk.). Singapore. (A.H.).
Chœrodon anchorago (Bl.). Fishmarket, Singapore. (J.H.).
C. oligacanthus (Blkr.). Fishmarket, Singapore. (J.H.).
Gomphosus pectoralis Q. and G. Christmas Island, Indian Ocean. (A.H.).
G. tricolor Q. and G. Fishmarket, Singapore. (J.H.).
Halichœres chloropterus (Bl.). Fishmarket, Singapore. (J.H.).
Hemigymnus melapterus (Bl.). Fishmarket, Singapore. (J.H.).

Hologymnosus semidiscus (Lac.). Fishmarket, Singapore. (J.H.).

Scarus dussumieri C.V. Horsburgh Lighthouse, South China Sea. (A.H.). Specimen described as "not typical".

Stethojulis kallosoma Blkr. Christmas Island, Indian Ocean. (A.H.).

Thalassoma lunare (L.). Fishmarket, Singapore. (J.H.); Johore. (A.H.).

LEIOGNATHIDÆ

Gerres abbreviatus Blkr. Fishmarket, Singapore. (J.H.).

G. oyena (Forsk.). Fishmarket, Singapore. (J.H.).

Leiognathus equulus (Forsk.). Fishmarket, Singapore. (J.H.).

L. insidiator Bl. Off Port Swettenham, Selangor. (A.H.).

L. ruconius (H.B.). Off Port Swettenham, Selangor. (A.H.).

LUTJANIDÆ

Cæsio cœrulaureus Lac. Fishmarket, Singapore. (J.H.).

C. chrysozonus Cuv. Fishmarket, Singapore. (J.H.).

C. erythrogaster (K. v. H.). Fishmarket, Singapore. (J.H.); Singapore. (A.H.).

Lethrinus miniatus (Schn.). Fishmarket, Singapore. (J.H.).

L. ornatus (C.V.). Fishmarket, Singapore. (J.H.).

L. ramak (Forsk.). Fishmarket, Singapore. (J.H.).

Lutjanus chrysotænia (Blkr.). Fishmarket, Singapore. (J.H.).

L. decussatus (C.V.). Fishmarket, Singapore. (J.H.).

L. erythropterus Bl. Fishmarket, Singapore. (J.H.); Siglap, Singapore. (A.H.).

L. fulviflamma (Forsk.). Pisang Island, Malacca Strait. (A.H.).

L. lineolatus (Rüpp.). Fishmarket, Singapore. (J.H.).

L. lutjanus Bl. East coast Malay Peninsula, Fisheries Dept. (A.H.).

L. spilurus (Bennet). Fishmarket, Singapore. (J.H.).

Monotaxis grandoculis (Forsk.). Fishmarket, Singapore. (J.H.).

Nemipterus hexodon (Q.G.). East coast Malay Peninsula, Fisheries Dept. (De B.).

Pentapus setosus C.V. Singapore. (De B.).

Scolopsis bilineatus (Bl.). Fishmarket, Singapore. (J.H.).

S. margaritifer (Cuv.). Fishmarket, Singapore. (J.H.).

S. monogramma C.V. Fishmarket, Singapore. (J.H.).

S. vosmaeri (Bl.). Fishmarket, Singapore. (J.H.).

MASTACEMBELIDÆ

Mastacembelus armatus C.V. Mawai District, Johore. (A.H.).

M. guentheri Day. Patani, Peninsular Siam. (A.H.).

M. maculatus C.V. River Benus, Pahang. (A.H.); Sadong River, Sarawak. (A.H.).

MONACANTHIDÆ

Chætoderma pencilligerus (Cuv.). Singapore. (A.H.).

Monacanthus chinensis (Cuv.). Fishmarket, Singapore. (J.H.); Siglap, Singapore; Sultan Shoal, near Singapore. (A.H.).

M. hajam Blkr. Fishmarket, Singapore. (J.H.).

Anacanthus scriptus (Foster). Fishmarket, Singapore. (J.H.).

Paramonacanthus cryptodon (Blkr.). Siglap, Singapore. (A.H.).

Psilocephalus barbatus (Gray & Hardw.). Siglap, Singapore; S.E. of Malay Peninsula, 30 fathoms, Fisheries Dept. (A.H.).

Stephanolepis tomentosus (L.). Siglap, Singapore. (A.H.).

MORINGUIDÆ

Aphthalmichthys abbreviatus Blkr. Mentawi Islands. (A.H.).

MUGILIDÆ

Mugil borneensis Blkr. Fishmarket, Singapore. (J.H.).

M. dussumieri C.V. Fishmarket, Singapore. (J.H.).

M. ophuyseni Blkr. Fishmarket, Muar, Johore. (A.H.).

M. subviridis C.V. Fishmarket, Singapore. (J.H.).

MULLIDÆ

Parupeneus barberinus (Lac.). Fishmarket, Singapore. (J.H.).

P. chryserydros (Lac.). Fishmarket, Singapore. (J.H.).

Upeneus sundaicus (Blkr.). Fishmarket, Singapore. (J.H.).

U. tragula Richards. Fishmarket, Singapore. (J.H.).

MURÆNIDÆ

Echidna nebulosa (Ahl.). Mentawi Islands. (A.H.).

Gymnothorax boschi (Blkr.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

G. flavimarginata (Rüpp.). Natuna Islands. (A.H.).

G. punctata (McClelland). Natuna Islands. (A.H.).

G. rüppelli (McClelland). Mentawi Islands. (A.H.).

G. thyrsoideus (Rich.). Off Tioman Island, South China Sea, 33 fathoms, Fisheries Dept. (A.H.).

NOTOPTERIDÆ

Notopterus chitala (H.B.). Chenderoh, Upper Perak. (A.H.).

ONCOCEPHALIDÆ

Halieutea stellata (Vahl.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

OPHICHTHYIDÆ

Ophichthus grandoculis (Cantor). Sandakan, British North Borneo. (A.H.).

OPHIOCEPHALIDÆ

Ophiocephalus melanopterus (Blkr.). Chenderoh, Upper Perak. (A.H.).

O. pleurophthalmus Blkr. Sauk, Upper Perak. (A.H.).

OSTRACIIDÆ

Ostracion tuberculatus L. Singapore. (A.H.).

PANGASIDÆ

Pangasius micronema Blkr. Chenderoh, Upper Perak. (A.H.).

PARAPERCIDÆ

Parapercis punctata (C.V.). East coast Malay Peninsula, Fisheries Dept.; Mentawi Islands. (A.H.).

PEMPHERIDÆ

Pempheris itoi Fowler. Fishmarket, Singapore. (J.H.).

P. mangula (Cuv.). Fishmarket, Singapore. (J.H.).

P. nyctereutes Jordon & Evermann. Fishmarket, Singapore. (J.H.).

PHALLOSTETHIDÆ

Neostethus bicornis Regan. Kranji, Singapore. (A.H.).

PLATYCEPHALIDÆ

Platycephalus celebicus Blkr. Mentawi Islands. (A.H.).

P. indicus (L.). Fishmarket, Singapore. (A.H.).

P. nematophthalmus Gthr. Johore Bahru, Johore, Fisheries Dept. (A.H.).

PLESIOPIDÆ

Plesiops melas Blkr. Mentawi Islands. (A.H.).

PLEURONECTIDÆ

Brachypleura novæ-zeelandiæ Gthr. East coast Malay Peninsula, Fisheries Dept. (A.H.).

Samaris cristatus Gray. Fishmarket, Singapore. (A.H.).

POLYNEMIDÆ

Polynemus sextarius (Bl. Schn.). Fishmarket, Singapore. (J.H.).

POMACENTRIDÆ

Abudefduf bengalensis (Bl.). Fishmarket, Singapore. (J.H.).

A. brownriggi (Bennett). Singapore. (A.H.).

A. saxatilis (L.). Fishmarket, Singapore. (J.H.); Singapore. (A.H.).

Chromis cinerascens (C.V.). Singapore Harbour. (A.H.).

C. dimidiatus (Klunz.). Fishmarket, Singapore. (J.H.); Sultan Shoal, near Singapore. (A.H.).

C. xanthochir Blkr. Singapore Harbour. (A.H.).

Pomacentrus fasciatus Cuv. Aor Island, South China Sea. (A.H.).

P. jerdoni Day. Off S.E. coast Malay Peninsula, Fisheries Dept. (A.H.).

P. littoralis Cuv. Tioman Island (fresh-water stream). (A.H.).

P. perspicillatus Cuv. Fishmarket, Singapore. (J.H.).

P. tripunctatus Cuv. Pisang Island, Malacca Strait. (A.H.).

P. violaceus Blkr. No data. (A.H.).

PSETTIDÆ

Psettus argenteus (L.). Fishmarket, Singapore. (J.H., A.H.).

RACHYCENTRIDÆ

Rachycentron canadus (L.). Fishmarket, Singapore. (J.H., A.H.).

SCIÆNIDÆ

Johnius coibor (Buch. Ham.). Fishmarket, Singapore. (J.H.).

J. dussumieri (C.V.). Malay Peninsula, Fisheries Dept. (De B.).

J. hypostoma (Blkr.). Kukub, West coast Johore, Fisheries Dept. (A.H.).

J. semiluctosus (C.V.). Off Muar, Malacca Strait, Fisheries Dept. (De B.).

Otolithes argenteus (C.V.). Sitiawan, Malacca Strait; Singapore. (De B.).

Otolithoides brunneus (Day). No data. (De B.).

Pama pama (H.B.). Bernam River, Perak, Fisheries Dept. (De B.).

Pseudosciæna aneus (Bl.). East coast Malay Peninsula, Fisheries Dept. (De B.).

P. birtwistlei Fowler. Off Perak River, west coast Malay Peninsula, Fisheries Dept. (De B.).

P. sina (C.V.). Malay Peninsula, Fisheries Dept. (De B.).

SCOMBRIDÆ

Rastrelliger kanagurta (Rüpp.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

SCORPÆNIDÆ

Pelor didactylum (Pall.). Sultan Shoal, near Singapore; Blakang Mati, Singapore. (A.H.).

Pseudosynanceia melanostigma Day. Kelantan. (A.H.).

Pterois miles (Bennett). Singapore. (A.H.).

P. radiata Cuv. Sipora Island, west coast Sumatra. (A.H.).

P. russellii (v. Hass.). Fishmarket, Singapore. (J.H.).

P. volitans (L.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

Scorpæna bleekeri Day. Fishmarket, Singapore. (J.H.).

Scorpænopsis diabolus (Cuv.). Off Tioman Island, South China Sea, Fisheries Dept. (A.H.).

Synanceia verrucosa (Bl. Schn.). Raffles Lighthouse, Singapore; Horsburgh Lighthouse, South China Sea. (A.H.).

SERRANIDÆ

Centrogenys vaigensis (Q.G.). Fishmarket, Singapore. (J.H.); Sultan Shoal, near Singapore; Johore Strait. (A.H.).

Cephalopholis urodelus (C.V.). Mentawi Islands. (A.H.).

Epinephelus cœruleopunctatus (Bl.). Fishmarket, Singapore. (J.H.).

E. corallicola (C.V.). Fishmarket, Singapore. (J.H.).

E. cyanostigma (C.V.). Fishmarket, Singapore. (J.H.).

E. diacanthus (C.V.). East coast Malay Peninsula, Fisheries Dept. (A.H.).

E. malabaricus (Bl. Schn.). Off Singapore. (A.H.).

E. merra Bl. Christmas Island, Indian Ocean; Mentawi Islands. (A.H.).

E. nebulosus (C.V.). Fishmarket, Singapore. (J.H.).

E. pachycentrum (C.V.). Fishmarket, Singapore. (J.H.).

E. tauvina (Forsk.). Fishmarket, Singapore. (J.H.).

Plectropoma maculatum (Bl.). Fishmarket, Singapore. (J.H., A.H.).

Variola louti (Forsk.). Fishmarket, Singapore. (J.H.).

SIGANIDÆ

Siganus concatenatus (Val.). Fishmarket, Singapore. (J.H.).

S. corallinus (Val.). Fishmarket, Singapore. (J.H., A.H.).

S. javus (L.). Fishmarket, Singapore. (J.H.); Johore Strait. (A.H.).

S. oramin (Schn.). Fishmarket, Singapore. (J.H.).

S. stellatus (Forsk.). Fishmarket, Singapore. (J.H.).

S. sutor (Val.). Fishmarket, Singapore. (J.H.).

S. virgatus (Val.). Fishmarket, Singapore. (J.H.).

S. vulpinus (Schl.). Fishmarket, Singapore. (J.H.).

SILLAGINIDÆ

Sillago maculata (Q.G.). Fishmarket, Singapore. (J.H.).

SILURIDÆ

Callichrous bimaculatus (Bl.). Near Sungai Lembing, Pahang. (A.H.).

Kryptopterus macrocephalus (Blkr.). Kota Tinggi, Johore. (A.H.).

SOLEIDÆ

Solea ovata Richardson. Penang, Fisheries Dept. (A.H.).

Zebrias altipinnis (Alcock). East coast Malay Peninsula, Fisheries Dept. (A.H.).

SPARIDÆ

Pentapodus macrurus (Blkr.). Fishmarket, Singapore. (J.H.).

Synagris tolu (Val.). Fishmarket, Singapore. (J.H.).

SPHYRÆNIDÆ

Sphyræna brachygnathus Blkr. Fishmarket, Singapore. (J.H.).

S. jello C.V. Fishmarket, Singapore. (J.H.).

STROMATEIDÆ

Stromateus cinereus Bl. Fishmarket, Singapore. (J.H.).

S. niger Bl. Fishmarket, Singapore. (J.H.).

SYNGNATHIDÆ

Chœroichthys brachysoma (Blkr.). Pawai and Blakang Mati, islets off Singapore. (A.H.).

Doryichthys deokhatoides (Blkr.). Mawai District, Johore. (A.H.).

D. martensi (Peters). Mawai District, Johore. (A.H.).

Trachyrhamphus serratus (Schl.). Siglap, Singapore. (A.H.).

SYNODONTIDÆ

Harpodon nehereus (H.B.). West of Pangkor Island, Malacca Strait, Fisheries Dept. (A.H.); Fishmarket, Singapore. (J.H.).

Saurida gracilis (Q.G.). Siglap, Singapore. (A.H.).

S. tumbil (Bl.). Off Tioman Island, South China Sea, 30 fathoms, Fisheries Dept. (A.H.); Fishmarket, Singapore. (J.H.).

TETRAODONTIDÆ

Chelonodon patoca (H.B.). Siglap, Singapore. (A.H.).

Spheroides lunaris (Schn.). Siglap, Singapore. (A.H.).

Tetraodon immaculatus (Schn.). Mentawi Islands. (A.H.).

T. leiurus Blkr. Ulu Jelai, Pahang. (A.H.).

T. meleagris (Schn.). Christmas Island, Indian Ocean. (A.H.).

T. multistriata (Richardson). No data. (A.H.).

THERAPONIDÆ

Helotes sexlineatus (Q.G.). Fishmarket, Singapore. (J.H.).

Therapon theraps C.V. East coast Malay Peninsula, Fisheries Dept. (De B.).

TRACHINIDÆ

Percis hexophthalma C.V. Fishmarket, Singapore. (J.H.).

TRIACANTHIDÆ

Triacanthus blochii Blkr. No data. (A.H.).

TRICHIURIDÆ

Trichiurus muticus Gray. Fishmarket, Singapore. (J.H.).

T. savala C.V. No data. (A.H.).

TRYPAUCHENIDÆ

Trypauchen vagina Bl. Schn. Siglap, Singapore. (A.H.).

URANOSCOPIDÆ

Uranoscopus bicinctus (Schlegel). East coast Malay Peninsula, Fisheries Dept. (A.H.).

Notes on Malayan reptiles

By M. W. F. TWEEDIE, M.A.

Although our knowledge of the reptilian fauna of the Malay Peninsula is now fairly complete, some of the species are known from very few examples and further records are useful in establishing their status in the Malayan fauna and defining the limits of their variation. In the present paper several such occurrences are recorded and a new species of *Lygosoma* is described.

Systematic.—Lygosoma trifasciatum sp. n.

SAURIA

Lygosoma trifasciatum sp. n.

SMITH 1922, p. 271; 1930, p. 38 (*L. larutense* part.).
SMEDLEY 1931 B, p. 112 (*L. larutense* part.).
SWORDER 1933, p. 103 (*L. larutense* part.).

Type.—A female from the Cameron Highlands, Pahang, 4,000–5,000 ft. taken in August 1937 by a collector of the Raffles Museum. Snout to vent length 148 mm.; total length 312 mm.; scale-rows, 32.

Material examined.—One from the Cameron Highlands, Pahang, 5,000 ft. (Smedley l.c.).

One from the Cameron Highlands (Sworder l.c.).

Six from the Cameron Highlands not previously recorded, one taken in 1931, one in 1932 and four in 1937.

One from Frasers Hill, F.M.S. No record of date or altitude but the locality indicates a height of over 4,000 ft.

Characters.—Near *L. larutense*, but distinguished by its larger size, greater number of scale rows (28–32) and by the presence of three more or less interrupted pale yellow bands on the neck and usually of small, scattered pale spots on the dark grayish-brown back and sides.

Description.—The pale bands on the neck afford the most conspicuous diagnostic feature. The anterior one, which is usually unbroken, runs over the nape, touching the posterior ends of the parietals; the next is usually more or less broken and is about half the length of the head behind the first; the last, which is often very incomplete, is an equal distance behind the second. Both posterior bands run forward at their lateral terminations and may be confluent with each other and with the first. The irregularly scattered pale spots, when present, are more numerous anteriorly.

Remarks.—The same collector who took the four specimens in the Cameron Highlands in 1937 also obtained three eggs about six inches deep in the earth beside a log. I opened one of these and found that the embryo was so far advanced as to be easily recognisable as *L. trifasciatum,* the three pale bands on the neck being as conspicuous as in adults. The eggs are covered with tough skin, whitish but discoloured by contact with the earth. The two that were not opened measure 22·5 × 12·5 mm. and 22 × 13 mm. The former is equally rounded at both ends, the latter slightly pointed at one end.

In recording specimens of this scink as *L. larutense,* Smedley (l.c. p. 113) states: "from a longer series it might be possible to differentiate two varieties, the typical form with 26 scale-rows and without the banded neck and a variety with 28–30 scale-rows, banded neck and attaining a larger size".

Now that the "variety" has been raised to specific rank it is of interest to note that its known distribution and that of the allied *L. larutense* are mutually exclusive. *L. trifasciatum* is found at high altitudes (4,000 ft. to over 5,000 ft.) on the mountains of the main range of the Peninsula and the Tahan massif (Smith ll.c.), while *L. larutense* has only been taken on the range of hills in the neighbourhood of Taiping in western Perak, which is separated from the main central range by the valley of the Perak River, and on a hill north of this locality in Kedah (Sworder, l.c.), Sworder's record from Kedah is based on a single specimen from Bukit T'Kabeh, 800 ft. The other recorded altitudes for *L. larutense* are 3,000 and 4,000 ft., and the Kedah specimen is abnormal in having only 24 scale rows. A longer series might prove this to be yet another species.

Lygosoma miodactylum Blgr.

BOULENGER 1912, p. 98.
SMITH 1930, p. 38.
SMEDLEY 1931 B, p. 113.

Three more specimens have been collected in the Cameron Highlands since those recorded by Smedley (l.c.), and one at Frasers Hill, taken by Sworder in August 1933. This is near the type locality (Semangko Pass) and is the second specimen collected in that region.

SERPENTES

Sibynophis collaris Blgr.

SMITH 1922, p. 265 (*Polyodontophis collaris*); 1930, p. 40.
SMEDLEY 1931 B, p. 114.

There are only two previous records of this snake from the Peninsula, one from Gunong Tahan (Smith l.c. 1922) and one from the Cameron Highlands (Smedley l.c.).

Three more specimens have since been collected, all from the Cameron Highlands at altitudes of 4,000–5,000 ft., two in 1931 and one in 1938. Details of lepidosis and dimensions are: 1931 (adult), Ventrals, 167; subcaudals, 91; total length, 510 mm.; tail, 150 mm. 1931 (juv.), Ventrals, 161; subcaudals, 96; total length, 198 mm.; tail, 59 mm. 1938 (adult), ventrals, 161; subcaudals, 94; total length, 478 mm.; tail, 158 mm.

Both the larger specimens are very dark in colour above, but the juvenile is light brown, the dark occipital and nuchal bars and vertebral stripe being very distinct.

Natrix conspicillata Günther.

SMITH 1930, p. 43.
SMEDLEY, 1932, p. 14.

In addition to the specimen from the Chikus Forest Reserve, Perak, mentioned by Smedley (l.c.) there is in the collection a somewhat macerated specimen labelled Kemaman, Trengganu, 1893, and one was taken at Sungai Siput, Perak in 1936, bringing the Malayan records up to four. Both the specimens from Perak have seven supralabials of which the 3rd and 4th enter the eye. The Kemaman example is typical in having eight of which the 3rd to the 5th touch the eye.

The snake from Sungai Siput was identified by Dr. Malcolm Smith and has been presented to the British Museum.

Elaphe prasina (Blyth).

SMITH 1922, p. 266; 1930, p. 48.

Two specimens of this snake, the second and third recorded from the Peninsula, are in the collection. One was taken in December 1921 on the lower slopes of Gunong Tahan, the scene of the first record, and the other in the Cameron Highlands in 1937, between 4,000 and 5,000 ft. Both are of the characteristic bright green colour and have a distinct pale line along the outer margin of the ventrals.

Gunong Tahan, 1921: ventrals, 206; subcaudals, 114; total length, 945 mm.; tail, 240 mm.; left preocular completely divided, right incompletely, both separated from frontal.

Cameron Highlands, 1937: ventrals, 204; subcaudals, 108; total length, 960 mm.; tail, 240 mm.; preoculars undivided, separated from frontal.

Calamaria gimletti Blgr.

BOULENGER 1912, p. 220.
SWORDER 1925, p. 100; 1929, p. 336.
SMITH 1930, p. 59.
SMEDLEY 1931 A, p. 52.

Two more specimens of this snake have been collected since 1930. One is from Bukit Chintamani, a limestone hill near Bentong, Pahang, August 1935, and the other from Aor Island, South China Sea, June 1938.

The Pahang specimen is unmarked above except for a pair of white spots one cm. from the tip of the tail and another about 1 mm. therefrom. That from Aor Island is more copiously marked than any of the previously recorded examples. There is a broad oblique white band six scales behind the occiput and irregularly disposed white spots, occupying one to three scales in a longitudinal direction, are scattered along the length of the body. They are larger posteriorly and the last three at 23, 12 and 4 mm. from the tip of the tail appear as complete transverse bands in dorsal view, though they do not actually extend down to the ventrals.

Bukit Chintamani, Pahang: Ventrals, 211; subcaudals, 17; total length 204 mm.; tail, 13 mm. Aor Island: ventrals, 230 mm.; subcaudals 11; total length, 165 mm.; tail, 6 mm.

Collorhabdium williamsoni Smedley.

SMEDLEY 1931 B, p. 120.

The species was described from four specimens collected in 1930 and 1931 in the Cameron Highlands; since then one more has been taken in the same locality in 1937.

In the recent example and the two of the original series which are in the Raffles Museum collection the fourth supralabial is as large as the third and the suture between them is vertical, as depicted in the figure B. on pl. II (l.c.) but not as in text-fig. 3*a* (l.c.), in which the suture is drawn oblique and the fourth supralabial small. In the 1937 specimen the dark coloration of the body extends very broadly onto the ventral shields, so that the white central area of each ventral is less than a third of its total width, except near the head and tail, where the dark lateral areas are relatively narrower.

Cameron Highlands, May, 1937: ventrals, 165; subcaudals, 26; total length, 250 mm.; tail, 27 mm.

Enhydris punctata (Gray).

SMEDLEY 1931 A, p. 53.

The only previous record of this snake in the Peninsula is from Kemaman, Trengganu (Smedley l.c.) where five immature specimens were collected in 1893. Another immature example was taken on Gunong Pulai, Johore in January 1934. It was identified by Dr. Malcolm Smith and is now in the collection of the British Museum. Ventrals, 140; subcaudals, 32.

Aipysurus eydouxi (Gray).

BOULENGER 1912, p. 195.
SMITH 1930, p. 71.
SMEDLEY 1931 A, p. 54.

Four specimens were taken in 1933 and 1934 from seine nets (*pukat*) at Siglap on the sandy southern shore of Singapore

Island. Their capture was incidental to the collecting of marine fish and invertebrates and appearances suggest that they are quite common. All four have 17 scale rows.

Ventrals, 141, 140, 139, 137; subcaudals, 24, 23, 22, 21.

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New and interesting Malaysian species of Sesarma and Utica (Crustacea, Brachyura)

By M. W. F. TWEEDIE, M.A.

(Plate XXIV)

The material described in this paper has been collected mainly during the last two years from the coasts and tidal rivers of Singapore and the Malay Peninsula; mention is also made of specimens from Labuan and comparative material from Celebes and the Philippine Islands has been lent by various museums.

Acknowledgements and thanks for these loans are due to the Directorates of the United States National Museum, the s'Rijks Museum van Natuurlijke Historie of Leiden and the Bureau of Science, Manila. To Dr. Isabella Gordon of the British Museum and Prof. Dr. H. Balss of Munich thanks are also due for their kindness in comparing material with types and authentic specimens in their respective museums, and to Dr. T. Sakai for sending specimens of the Japanese species *Sesarma bidens* de Haan.

In referring to species of *Sesarma* I have deemed it best not to recognise the four subgenera proposed by de Man and amended taxonomically by Rathbun.[1] This classification has its practical uses but is almost entirely artificial. Moreover the presence or absence of an epibranchial tooth is not a reliable character. Several species are variable in this respect and it has been used to separate subgenerically species which are very closely allied, *e.g. S. granosimana* and *S. crassimana.*

The terminology used in describing the structure and orientation of the first pleopod of the male is based on that employed by Gordon (1937, p. 152, 154) and refers to the position of the pleopod *in situ, i.e.* before it is removed for examination and figuring. The concave surface that lies against the thoracic sternal segments is called the sternal surface, a figure showing which is said to be drawn from the sternal aspect. The opposite side, lying against the abdomen, is referred to as the abdominal surface; in most species of *Sesarma* the pleopod is triangular in cross section and an outer and inner abdominal facet can be distinguished. When *in situ* the outer facet lies against the inner surface of the abdominal segments and the inner facet

1. *Sesarma* s.s. *Parasesarma, Cheiromantes* and *Holometopus.*

against the hinder part of the alimentary canal. The most important feature systematically is the distal chitinous projection which is normally very constant in shape and relative size in any given species and sometimes affords the most reliable means of distinguishing closely similar forms.

For the sake of uniformity the right pleopod has been extracted and figured in every case and, unless otherwise stated, has been drawn resting on the outer abdominal facet with the distal end upwards and the chitinous projection pointing towards the right. In most cases the pleopod rests naturally on a flat surface in this position and the chitinous projection is seen in profile.

Systematic.—

Sesarma versicolor sp.n.
Sesarma sediliensis sp.n.
Sesarma johorensis sp.n.
Sesarma penangensis sp.n.
Sesarma bidens indiarum nom. nov. for *Sesarma bidens indica* de Man preoccupied by *Sesarma indica* H. Milne Edwards.

Sesarma edwardsi var. *crassimana* de Man is raised to specific rank and the males of *Sesarma pontianacensis*, *S. palawanensis* and *Utica borneensis* are described for the first time.

The types of the new species will be deposited in the British Museum.

Sesarma andersoni de Man.

DE MAN 1887, p. 657; 1887–88, p. 172, Mergui.
TESCH 1917, p. 129.
KEMP 1918, p. 234.

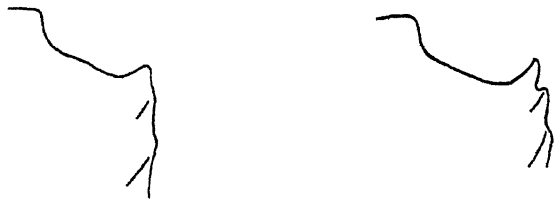
Material.—A good series from Kuantan, Pahang, on the east coast of the Peninsula and a smaller series from Prai, opposite Penang Island on the west coast.

Remarks.—Kemp (1915 p. 239) mentions a "short ridge on either side of the carapace, strictly transverse in direction, situated close behind the middle of the orbit". This feature was not mentioned in de Man's original description and I am unable to find it in any of the present series.

The species is recorded previously from Mergui and Trang on the west coast of Peninsular Siam. Its occurrence at Penang affords, therefore, merely a slight southward extension of the known range, but its presence at Kuantan is hard to explain unless a fairly recent marine or palustrine connection across the Isthmus of Kra is postulated, since intensive collecting has not revealed the species at Singapore or at more southern localities on the coasts of the Peninsula.

Sesarma batavica Moreira. Fig. 1.

DE MAN 1890, p. 104 (*S. barbimana*), Batavia.
MOREIRA 1903, p. 117.
KEMP 1915, p. 238.
TESCH 1917, p. 132.
TWEEDIE 1936, p. 63.



a *b*

Fig. 1. *Sesarma batavica.* Antero-lateral region of carapace of specimens showing (*a*) the normal condition and (*b*) a well developed epibranchial tooth.

Material.—Localities in addition to those listed in Tweedie, 1936 are Kuantan, Pahang; and Prai, opposite Penang Island.

Remarks.—The condition of the lateral margin behind the antero-lateral angle is very variable. Sometimes the margin is quite unbroken; usually a trace of an epibranchial tooth is present and occasionally a definite tooth is found. This condition is illustrated in fig. 1*b* and the normal condition in *a*.

Sesarma bocourti A. Milne Edwards.

A. MILNE EDWARDS 1869, p. 28, Bangkok.
DE MAN 1895, p. 169.
TESCH 1917, p. 135.
ROUX 1933, p. 13.

Material.—A good series from fresh-water swamp near Kota Tinggi, Johore.

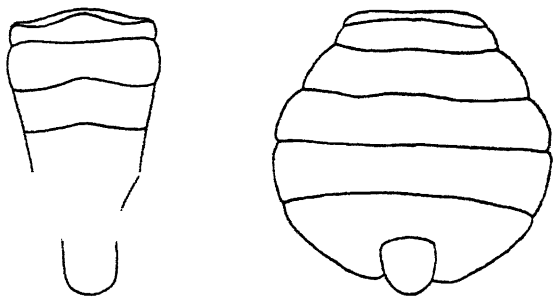
Remarks.—In his description of specimens from Borneo and Sumatra Tesch (l.c.) records a variation in the proportions of the abdominal segments of the male, describing a single specimen from Balikpapan, in Borneo in which they are unusually broad, the hind margin of the penultinate segment being 2·8 times its length. In the present series this ratio varies from 2·08 to 2·34, the tendency being for the segments to be broader in small specimens. In the two specimens described by de Man (1895, p. 169–171) from Pontianak, Borneo and Condore Island the ratio falls within this range.

None of the specimens in the present series exhibits the row of granules on the inner surface of the palm observed by Tesch in examples from Balikpapan, East Borneo; and Deli, Sumatra.

If *Sesarma cheirogona* Targioni Tozzetti from Yokohama (1877, p. 141) is really identical with *bocourti*, I am inclined to think that the specimen was wrongly localised. It was collected during the world cruise of the "Magenta", which included visits to Borneo and Sumatra.

Sesarma pontianacensis de Man. Fig. 2.

DE MAN 1895, p. 178, Pontianak, W. Borneo.
NOBILI 1903, p. 27.



a *b*

Fig 2. *Sesarma pontianacensis*. Outlines of abdominal segments of (*a*) male and (*b*) female.

Material.—A series of both sexes from Singapore; Tanjong Balai, Karimon Islands; and Prai, Province Wellesley, 12/1938.

Remarks.—Previous records of this species are confined to the single female from which the species was described and a female recorded by Nobili (l.c.) from Samarinda, south-east Borneo.

In the male the form of the carapace is similar to that of the female. The chelæ are somewhat larger, the palms being considerably inflated. The outer surface of the hand, except the tips of the fingers, is coated with woolly hair; the inner surface of the palm is naked or sparsely hairy and carries no granules or raised ridge. The upper surface of the dactylus carries a longitudinal ridge which, under strong magnification, can be seen to be very finely milled. Near the base and external to this ridge the upper surface of the dactylus is hairy but elsewhere it is naked.

The male abdomen (fig. 2*a*) is narrow and its terminal segment very long. The female abdomen (fig. 2*b*) is very broad and almost circular in shape.

The largest female is 4·5 mm. in anterior carapace breadth and 5·3 mm. long; a much smaller specimen is ovigerous. The corresponding measurements of the largest male are 3·8 mm. and 4·5 mm.

Sesarma granosimana Miers.

MIERS 1880, p. 312, Indo-Malayan Seas.
TESCH 1917, p. 155.
ROUX 1933, p. 10.

Material.—A good series from fresh-water swamp-forest near the river Sedili, Johore. A single specimen from among nipah palms beside the river Sedili, where the water is slightly saline.

Remarks.—The species has been recorded from Pontianak, Borneo by de Man and from Palembang, Sumatra by Roux.

Sesarma crassimana de Man.

DE MAN 1887, p. 649, Bay of Bengal, 1887–88, p. 188; 1895, pp. 143, 174 (*Sesarma edwardsi* var. *crassimana*).
TESCH 1917, p. 148 (*S. edwardsi crassimana*).

Material.—An adult male and female and a smaller male from among nipah palms beside the river Sedili, Johore.

Remarks.—I prefer to regard this crab as a separate species rather than as a variety of *S. edwardsi* de Man. That author has remarked on its resemblance to *S. granosimana* Miers (l.c. 1895, p. 143) and in my opinion it is more closely related to that species than to *edwardsi*. As de Man points out the form, details of dentition and even the colour of the chelæ, and also the shape of the abdominal segments, are almost identical in *granosimana* and *crassimana*, the only conspicuous difference between them being the presence of an epibranchial tooth in the latter. I find also that the meri of the walking legs are differently shaped in these two species. In *crassimana* those of the penultimate pair are, as de Man says, a little more than half as broad as long. In the specimens of *granosimana* that I have before me they are broader still, the ratio of breadth to length being about 1: 1·7 as against 1: 1·9 in *crassimana*. In the table of measurements given by de Man in 1895, p. 148, three *granosimana* give a ratio of 1: 1·7 and one of 1: 1·8. In the single *crassimana* measured the ratio is 1: 1·8.

Sesarma moeschii de Man. Fig. 3; Plate xxiv, 1.

DE MAN 1887–88, p. 182 (*S. intermedia*), Mergui; 1892, p. 331; Deli, Sumatra.
TESCH 1917, p. 177.

Material.—One adult male from among nipah palms beside the river Sedili, Johore, measuring 16·2 mm. in anterior carapace breadth.

Remarks.—By courtesy of Prof. Dr. H. Boschma, Director of the Leiden Museum, I have been able to examine the specimen recorded by Tesch (l.c.) from Celebes. It appears to agree with the Malayan specimen in every respect except for the proportions of the abdominal segments (fig. 3*a*, *b*), the penultimate segment being much broader in the Celebes specimen. If sufficient

material were available from both localities to prove this difference to be constant, it would be sufficient for sub-specific distinction.

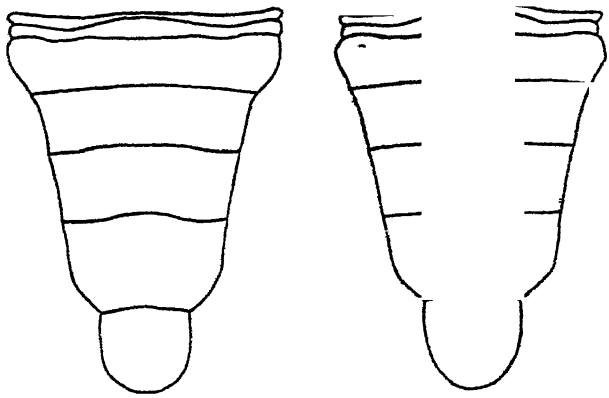


Fig. 3. *Sesarma moeschii.* Outlines of abdominal segments of males from (*a*) Johore and (*b*) Celebes.

Sesarma polita de Man.

DE MAN 1887, p. 654; 1887–88, p. 189, Mergui.
TESCH 1917, p. 190.

Material.—A single male from among nipah palms beside the river Sedili, Johore.

Remarks.—This distinctive species was known hitherto only from the Mergui archipelago.

Sesarma bidens indiarum nom. nov.

DE MAN 1902, p. 541 (*Sesarma bidens* var. *indica*), Amboina and Ternate. nec *Sesarma indica*, H. Milne-Edwards, 1837, p. 74.
TESCH, 1917, p. 135 (*Sesarma bidens indica*).

Material.—Specimens from Singapore; Kuantan, Pahang; Prai, Province Wellesley; Simalur Island, West Sumatra.

Remarks.—I have compared examples from Japan, kindly provided by Dr. T. Sakai, with Malaysian material, and agree with previous authors that the two forms are geographical races of a single species. It seems most probable that typical *bidens* is restricted to the Japanese area.

S. b. indiarum may be distinguished from *S. b. bidens* by its narrower abdomen; the sharper and more outwardly directed antero-lateral teeth and more oblique orbits; and the longer and more slender walking legs. The breadth: length ratio of the meri of the penultimate legs is about 1:2 in *bidens* and 1:2·1–2·2 in *indiarum*.

The male pleopods are not significantly different.

Sesarma mederi H. Milne Edwards. Fig. 4.

WHITE 1847, p. 38 (*S. taeniolata* nom. nud.), Philippine Islands.
H. MILNE-EDWARDS 1853, p. 185, Batavia.
TESCH 1917, p. 201 (*S. taeniolata*).
TWEEDIE 1936, p. 53. (*S. taeniolata*).

Material.—Two males from Muar, Johore; one female (juv.) from Singapore; two males, two females from Prai, Province Wellesley; four males and two females from Labuan; one male from Iloilo Province, Philippine Islands (on loan from the Bureau of Science, Manila). A male from Labuan was compared with the type of *S. taeniolata* in the British Museum by Dr. I. Gordon and found to be the same. The largest specimen is a male from Labuan measuring 40 mm. in anterior breadth.

Remarks.—This species may be taken as representative of a series of closely allied, large species of *Sesarma* which also includes *S. palawanensis* Rathbun, *S. lafondi* Jacq. et. Luc., *S. tetragona* Fabr., *S. singaporensis* Tweedie and *S. versicolor* sp.n. (*infra*). Of these all except *lafondi* and *tetragona* are in the present collection. The discrimination of some of the species is by no means easy. In the males the most useful characters are the form of the first pleopod and the number of tubercles on the dactylus of the chela.

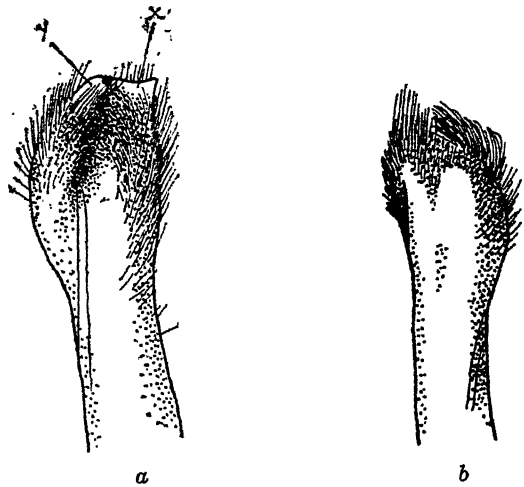


Fig. 4. *Sesarma mederi.* Right first pleopod of male from (*a*) sternal and (*b*) abdominal aspect.
x, laminar chitinous projection; *y*, supplementary chitinous projection.

In the present species the number of tubercles on the dactylus seems from the available series to be about 50–55 in males measuring 35–40 mm. in anterior carapace breadth. The type of *taeniolata* White from the Philippines is exceptionally

large (45 mm. in anterior breadth) and has 62–64 tubercles; the specimen from Iloilo Province has 55 equalling the maximum observed in the Malaysian series.

The first male pleopod (fig. 4*a*, *b*) is expanded at the tip and bears a broad laminar chitinous projection, pointed or angular at its outer distal extremity (fig. 4*a*, *x*). On the inner margin of the expanded tip of the pleopod a lobe arises which curves over the sternal surface and bears at the tip another narrow chitinous projection (fig. 4*a*, *y*) which, in sternal aspect, overlaps the inner end of the first.

The curved granular ridge on the inner surface of the palm is present in both sexes and in old males is extremely prominent. The epibranchial teeth are prominent and project outwards distinctly more than the antero-lateral teeth, the distance between them from side to side being about 1–2 mm. more than the anterior breadth in large specimens.

The female is immediately distinguished from all the other closely similar members of the group by the presence of a pectinated ridge on the palm of the chela, like that of the male.

Sesarma palawanensis Rathbun. Fig. 5.

RATHBUN 1914, p. 72, Palawan Island, Philippines.
TESCH 1917, p. 183.
TWEEDIE 1936, p. 53 (*S. taeniolata*, part) and p. 54 (*S. palawanensis*, part.

Material.—Two adult and three sub-adult males from Singapore; Two adult and one sub-adult females from Singapore; One adult female from Kuantan, Pahang; one female paratype from Nakoda Bay, Palawan Island, Philippines (on loan from the U.S. National Museum).

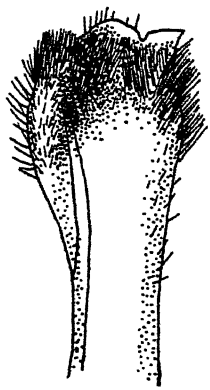


Fig. 5. *Sesarma palawanensis.* Right first pleopod of male from sternal aspect.

Remarks.—Up to the present the male of this species has not been described, all the males and some of the females recorded under the name *palawanensis* by myself (1936, p. 54) being referable to *S. versicolor* sp.n. *infra.* Comparison of recently collected adult males of *palawanensis* with *mederi* also revealed that three sub-adult males from the Johore Straits and Singapore, referred by me previously to *S. taeniolata* (= *mederi*) belong to the present species.

In the two large males of *palawanensis* the dactylar tubercles number 66, 67 and 69, 70, their anterior carapace breadth being respectively 38·8 mm. and 36·5 mm. in two smaller males, about 30 mm. in breadth the tubercles number 63, 64 and 67, 68. The maximum and average is therefore significantly higher than in *mederi.*

The first male pleopod (fig. 5) is similar at first sight to that of *mederi.* The laminar chitinous projection is, however, more prominent and the inner margin of the expanded tip is slightly inflated, is not produced into a lobe and bears no supplementary chitinous projection. This affords the most reliable means of distinguishing between the males of the two species. The edge of the laminar chitinous projection in *palawanensis* is more or less emarginate, but the sharp notch in that of the figured specimen may be due to an injury.

As stated in the original description the carapace is narrower than in *S. mederi,* its median length being usually 95–97% of the anterior breadth. The front and the outer post-frontal lobes are also relatively narrower, all characters which also distinguish the species from *S. singaporensis.* Another characteristic feature of *palawanensis* is that in both sexes the epibranchial teeth are less prominent laterally than the antero-lateral teeth, so that the distance between them is less than the anterior breadth. The tufts of hair on the surface of the carapace are smaller and finer than in the allied species and the walking legs are considerably longer and more slender.

In the original description it is stated that there is no granular ridge on the inner surface of the palm, an observation based on a series of females only. In the males this ridge is present, though it is rather shorter and less prominent than in *S. mederi.* Traces of it exist, moreover, in the largest females from Singapore. There is no pectinated ridge on the palm of the female.

Measurements of largest male from Singapore.

Carapace.—

Anterior breadth	38·8 mm.
Breadth between epibranchial teeth	38
Posterior breadth	17
Median length	37·2
Breadth of front	19

Abdomen.—		
Length (segments measured serially) ..	30·8	mm.
Breadth at third segment	19·4	„
Length of penultimate segment ..	7·4	„
Basal breadth of penultimate segment ..	14·1	„
Length of last segment	6·5	„
Basal breadth of last segment ..	6	„
Right Chela.—		
Total length of chela	34	„
Height of palm	19	„
Length of dactylus	23·8	„
Penultimate Walking Leg.—		
Length of merus	33·5	„
Greatest breadth of merus	13·5	„
Combined length of carpus and propodus ..	37·7	„
Length of dactylus	17·1	„

Sesarma singaporensis Tweedie. Fig. 6.

TWEEDIE 1936, p. 53, Singapore.

Material.—Ten adult and sub-adult males and six females from Singapore, in addition to the original series; three males and a female from Prai, Province Wellesley.

Remarks.—Subsequent collecting has shown that the specimens from which this species was originally described were not fully adult. The anterior breadth of the carapace of the type is 32 mm. Several larger males have now been collected, the largest measuring 38·5 mm. in breadth. In these larger specimens the number of tubercles on the dactylus of the chela is greater than was first recorded, the maximum observed being 46 as opposed to 37 in the type. From the present series it appears that in males ranging from 30 to 38 mm. in breadth the dactylar tubercles normally range from about 36 to 46; none of the specimens of 33 mm. or over have less than 40 tubercles.

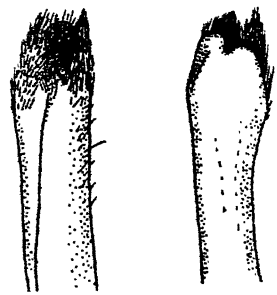


Fig. 6. *Sesarma singaporensis.* Right first male pleopod from (*a*) sternal and (*b*) abdominal aspect.

Examination of this series has also revealed some further characters distinguishing the species from *S. mederi* and *S. palawanensis*. In those species the dactylar tubercles are almost the same length (measured along the axis of the finger) throughout, but in *singaporensis* they increase gradually in length, those near the tip being more than twice as long as those near the base.

The first male pleopod (fig. 6*a*, *b*) is very slightly expanded at the tip and quite distinct from that of any of the allied species.

In both sexes the carapace is considerably broader than in *palawanensis*, the median length being usually about 92% of the anterior breadth; the front is more than half the anterior breadth which is equal to or slightly less than that between the epibranchial teeth. The meri of the walking legs are very broad, sometimes nearly half as broad as long. The absence of a pectinated ridge on the palm distinguishies the female from that of *mederi*.

In both average and maximum size the available series of *singaporensis* is smaller than those of *mederi* and *palawanensis*.

Sesarma versicolor sp. n. Fig. 7.

TWEEDIE 1936, p. 54 (*S. palawanensis*, part).

Cotypes.—An adult male and female from Singapore Island, February 1939.

Material.—Four adult and sub-adult males and seven females, in addition to the types, from Singapore, 1934, 1935, 1939; Six adult males and two females from Prai, Province Wellesley, 12/1938; a male and female from Kuantan, Pahang, 1935.

Description.—A species of *Sesarma* related to *S. mederi*, *S. palawanensis* and *S. singaporensis*, and characterised by the following features: the carapace is broader than long, the median length being usually 93–95% of the anterior breadth; the greatest breadth is between the epibranchial teeth. The surface is beset with rather large tufts of hair. The breadth of the front is half or less than half the anterior breadth of the carapace and the inner post-frontal lobes are one and a half or more times as broad as the outer, features in which the species resembles *S. palawanensis*. The abdomen of the male (fig. 7*a* and Tweedie, 1936, fig. 1*b*) is narrow, the length of the penultimate segment being 60% or more of its basal breadth. This character alone is sufficient to distinguish the male from that of any of the three allied species, in which the percentage is about 50–53.

The tip of the first male pleopod (fig. 7*b*) is less expanded than that of *mederi* and *palawanensis*. The chitinous projection is laminar, but its outer distal extremity is low and rounded,

not acutely angular. Its inner margin curves sharply round on itself, so that in end view the distal edge of the projection is hook-shaped. The short, reflexed part stands on the distal portion of the inflated inner margin and is homologous with the detached supplementary chitinous projection on the pleopod of *mederi*.

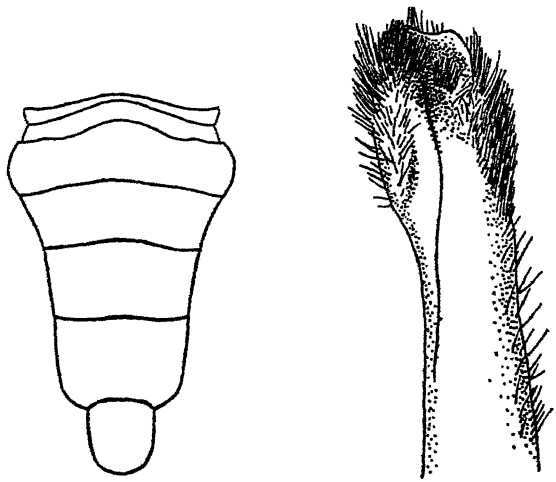


Fig. 7. *Sesarma versicolor*. *a*, outline of male abdominal segments; *b*, right first pleopod of male in sternal aspect.

In fresh specimens the coloration of the chelæ is the most conspicuous specific feature, and is common to both sexes. Externally the palm is purple on its basal two-thirds and on its upper part this colour extends distally to the dactylar articulation and in a tapering strip along the upper surface of the dactylus. The rest of the palm, the immovable finger and the outer surface of the dactylus are white. The purple coloured surfaces are granular-rugose and the white are smooth and sparsely punctate. The granular ridge on the inner surface of the palm is less prominent and rather longer than in the allied species and is developed in both sexes. In adult males the basal part of the biting edge of the immovable finger is expanded into a broad molariform process. In the male cotype the number of tubercles on the dactyli is 53, 53. Other specimens of 35–37 mm. in anterior breadth have 45–50 tubercles and the number does not fall below 40 in adults. As in *singaporensis* the tubercles increase in length from base to tip of the finger, the increase

being gradual up to the last three or four tubercles and then becoming very marked. The last one is greatly elongated, equalling as many as four or five of the most proximal ones. In the female the tubercles are fewer in number and are confined to about the proximal half of the dactylus. A pectinated ridge is present on the palm of the male but not on that of the female.

The walking legs are intermediate in their proportions between *mederi* and *palawanensis*.

Measurements of the male cotype.

Carapace.—		
Anterior breadth	38·6	mm.
Breadth between epibranchial teeth	39·5	„
Posterior breadth	15·5	„
Median length	36·4	„
Breadth of front	19	„
Abdomen.—		
Length (segments measured serially)	31·3	„
Breadth at third segment	19	„
Length of penultimate segment	6·7	„
Basal breadth of penultimate segment	11	„
Length of last segment	6·1	„
Basal breadth of last segment	5·9	„
Right Chela.—		
Total length of chela	32	„
Height of palm	20·2	
Length of dactylus	22·5	
Penultimate Walking Leg.—		
Length of merus	31	
Greatest breadth of merus	13·8	
Combined length of carpus and propodus	35	„
Length of dactylus	12·5	„

Sesarma sediliensis sp. n. Fig. 8; Plate xxiv, 2.

Cotypes.—An adult male and female collected on the bank of the river Sedili in east Johore by the writer in March, 1938.

Material.—The types and a series of sub-adult specimens from the type locality.

Description.—The carapace is distinctly convex longitudinally and slightly so from side to side. The breadth between the antero-lateral angles is always slightly more than the median length; in adult males the length averages 91–92% of the breadth and in females in which the carapace is slightly broader about 88%. The lateral margins carry a tooth behind the antero-lateral angle and an indication of a second epibranchial tooth is present in the form of a notch behind the first; they are nearly parallel, diverging backwards only slightly from a point behind the first epibranchial teeth, between which lies the greatest breadth of the carapace. The front is moderately prominent and is not concealed by the post-frontal lobes; it is emarginated in the middle, the emargination occupying between a third and a quarter of its total breadth. The surface of the carapace is

distinctly sculptured; the groove separating the inner post-frontal lobes being deep and that bounding the mesogastric region well defined. Of the post-frontal lobes the inner project slightly farther forward than the outer and are about one and a half times as broad; the anterior margins of all four lobes are indented and setose. Small setiferous punctæ are scattered sparsely all over the carapace, being most numerous on the branchial regions.

In the abdomen of the adult male the shape of the penultimate segment is peculiar (fig. 8*a*). Its distal margin embraces the last segment more than is usual in *Sesarma*, and the lateral margins are notched where they curve round to join the distal margin on each side; in sub-adult specimens the notches are scarcely perceptible. The greatly produced, tubular chitinous projection of the first male pleopod (fig. 8*b*) is highly characteristic of the species.

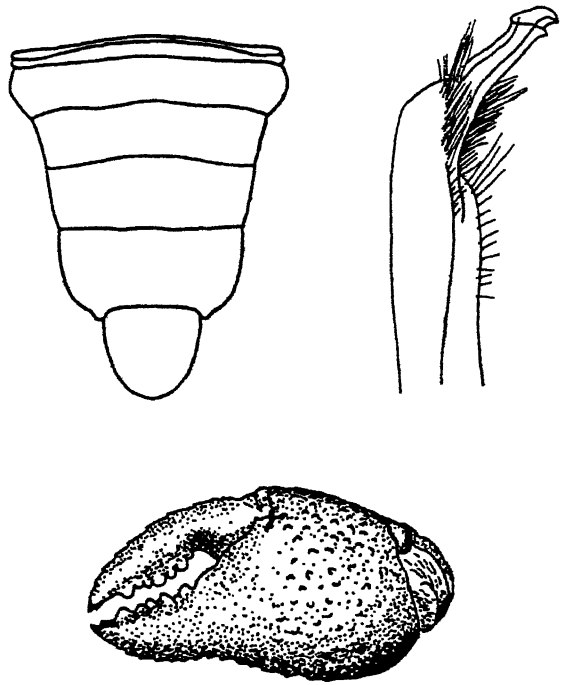


Fig. 8. *Sesarma sediliensis*. *a*, outline of male abdominal segments; *b*, right first pleopod of male; *c*, left (larger) chela of male cotype.

In the chelipeds the upper border of the arm ends in a sharp tooth, the outer border is granular and the lower is denticulate, the denticles being blunt and expanded to form a flattened lacinate projection near the distal end. The carpus bears a flattened tooth on its inner surface, entire in the sub-adult specimens, but broken up into several small denticles in the type. The upper surface of the carpus is granular, the granules becoming squamiform towards the meral articulation. The upper margin of the palm of the chela (fig. 8*c*) is bounded by a granular ridge; its outer surface is uniformly granular, the granules being small and low. The under surface of the palm and immovable finger is beset with larger granules. The inner surface is sparsely granular and in the type a few larger granules are arranged in a vertical series, but do not form a definite ridge. The upper margin of the dactylus carries in the male 8–12 small, blunt, distally directed teeth in a series extending nearly to the tip; interior to this row of teeth are a few scattered granules, similar in form to the teeth but rather smaller. In the female the granulation of the chelæ is reduced to a fine rugosity and the ornamentation of the dactylus to two or three small granules near the articulation. Both fingers end in sharp, horny points. The dentition of the inner margins of the fingers shows no unusual characters; the teeth on the dactylus tend to form a group towards the middle of the finger, especially in large specimens.

In the male type the chelipeds are very unequal, the left being much the larger. About half the sub-adult specimens show a slight inequality and it seems probable that this is a natural condition, being emphasised with age, and not the result of mutilation and subsequent regeneration.

The walking legs are short and stout; the meri are broad, their maximum breadth being near the distal end and decreasing rapidly towards the proximal.

In life the chelipeds are bright red and the carapace dark brown, more or less variegated with greenish.

S. sediliensis comes down to category 41 in Tesch's key to *Sesarma s.s.* (1917, p. 248). It is distinguished from *S. modesta* de Man (1902, p. 511, Pl. xix, fig. 8) by the shape of its carapace, the sides of which are less divergent backwards, and by the broader and deeper grooves separating the post-frontal lobes; those separating the inner and outer lobes extend much further back in *sediliensis*. The shape of the male abdomen is very different in the two species (c.f. fig. 8*a* and de Man l.c. Pl. xix, fig. 8*b*), and the outer surface of the palm of the chela lacks the confluent wrinkles characteristic of *modesta*.

From the very variable *S. impressa* H.M.E. *S. sediliensis* is distinguished by the absence of the concavity on the immovable

finger characteristic of that species and by its much shorter and stouter walking legs. In *sediliensis* the total length of the penultimate leg is less than twice the anterior breadth of the carapace; in *impressa* (c.f. de Man, 1902, p. 531) it is always more than twice and usually more than two and a half times the breadth. The meri in *sediliensis* are less than twice as long as broad but distinctly more in *impressa*. The usual (but apparently not invariable) strong backward divergence of the lateral borders of the carapace in *impressa* is not seen in *sediliensis*.

Remarks.—These crabs were found among the stems of nipah palms (*Nipah fruticans*) growing in mud on the banks of the river Sedili. The water in the part of the river where the palms grow is slightly brackish with incursions of fresh water when the river floods. Its salinity never approaches that of the open sea.

Measurements of the male cotype—

Carapace.—		
Anterior breadth	25·5	mm.
Breadth between epibranchial teeth	26·6	„
Posterior breadth	13	„
Length	23·5	„
Breadth of front	15·4	„
Abdomen.—		
Length (segments measured serially)	19·2	„
Breadth at third segment	13·4	„
Length of penultimate segment	3·8	„
Basal breadth of penultimate segment	9·4	„
Length of last segment	5·0	„
Basal breadth of last segment	5·0	„
Larger (Left) Chela.—		
Total length of chela	21·0	„
Height of palm	11·0	„
Length of dactylus	12·2	„
Penultimate Walking Leg.—		
Length of merus	16·7	„
Breadth of merus	9·0	„
Combined length of carpus and propodus	18·4	„
Length of dactylus	8·5	„

Sesarma johorensis sp.n. Fig. 9; Plate xxiv, 3.

Cotypes.—An adult male and a sub-adult female from mangrove swamp near the river Pendas in south Johore, taken by the writer in February, 1937.

Material.—Two sub-adult males and two females in addition to the types from the same locality.

Description.—The carapace is shallow and rather flat, its surface smooth with a few widely scattered punctæ. The median length is less than the anterior breadth (87% in the male type). The lateral margins are nearly parallel and slightly concave; there is a small epibranchial tooth just behind each external

orbital angle, and the breadth of the carapace between these teeth is a trifle less than the anterior breadth; no trace of a second epibranchial tooth is present. The front is prominent and very broad with a shallow median emargination, the orbits being correspondingly short and oblique. The post-frontal lobes are rounded and well defined anteriorly, the inner pair a little broader than the outer and projecting rather further forward. The grooves separating the inner and outer lobes are short, extending backwards for a distance about equal to the breadth of the outer lobes. Those that diverge from the division between the inner lobes and define the anterior part of the mesogastric region are also short and do not extend backwards to enclose the mesogastric region. The hepatic region is slightly rugose and carries a low, transverse tubercle.

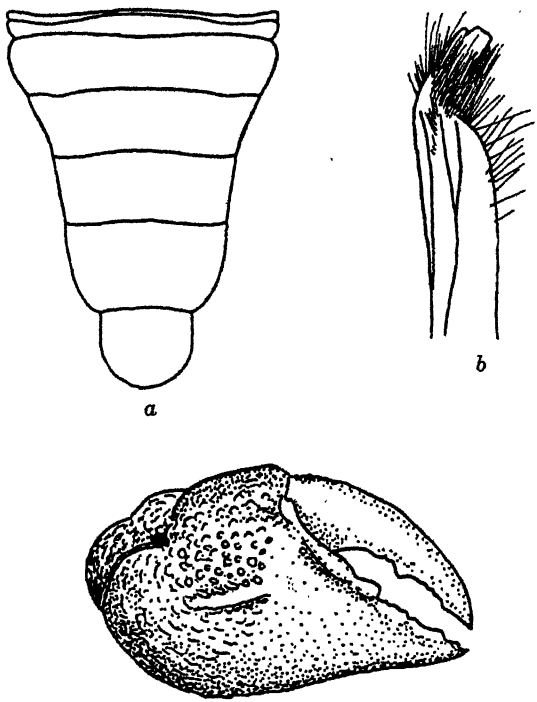


Fig. 9. *Sesarma johorensis*. *a*, outline of male abdominal segments; *b*, right first pleopod of male; *c*, right chela of male.

The male abdomen (fig. 9*a*) is rather narrow and the first pleopod (fig. 9*b*) shows no remarkable features.

The chelipeds (fig. 9*c*) are equal. The borders of the merus are unarmed and the inner angle of the carpus is rounded. The outer surface of the carpus and of the lower half of the proximal part of the palm carry squamiform markings; there are some low, smooth granules on the upper part of the palm and in the middle of its outer surface is a short longitudinal ridge, developed just as in *S. moeschii* de Man. The rest of the outer surface of the palm and of both the fingers is smooth. That part of the palm bordering the lower half of the dactylar articulation is raised into a smooth rim externally and internally into two unequal elongated tubercles. The inner surface of the palm also bears a prominent curved granular ridge. The upper border of the palm carries a number of irregular, finely beaded lines which converge towards the carpal articulation to form a ridge. The upper surface of the dactylus is ornamented with small, irregularly arranged granules in its proximal half only.

In the walking legs the meri carry the usual anterior distal spine and all except the last have, on their upper surface, short, transverse squamiform markings. The proportions of the penultimate leg are indicated in the table of measurements.

The colour of the carapace is very dark greenish brown and of the chelæ, pale yellow.

S. johorensis appears to be allied to *S. moeschii* de Man. In that species the carapace is more vaulted and deeper than in *johorensis* and the inter-regional grooves are more deeply incised; in particular those separating the post-frontal lobes are deeper and extend further back and that surrounding the mesogastric region is not interrupted. The carapace of *johorensis* is uniform dark brown; that of *moeschii* is conspicuously marbled. The chelipeds are similar in the two species but in *johorensis* the fingers are rather shorter; they also differ markedly in colour, those of *johorensis* being pale yellow in life and of *moeschii* orange-red. The walking legs are rather more slender in *johorensis*.

The species can be traced in Tesch's key to *Sesarma* s.s. (1917) as far as category 15 (p. 242). In the proportions of the meri of its walking legs it is intermediate between 16 and 32. If it is referred to the latter its characters lead it to *S. moeschii*, from which it differs as stated above. Referred to category 16 it comes down to the Chinese and Japanese *S. intermedia* de Haan and *S. sinensis* H.M.E., (now regarded as identical) with which it does not appear to have any close affinity.

Measurements of the male cotype—

Carapace.—

Anterior breadth	13·5	mm.
Breadth between epibranchial teeth ..	13·0	„
Posterior breadth	6·5	„
Length	11·7	„
Breadth of front	8·4	„

Abdomen.—		
Length (segments measured serially) ..	9·4	mm.
Breadth of third segment	6·6	„
Length of penultimate segment ..	2·1	„
Basal breadth of penultimate segment ..	4·0	„
Length of last segment	2·1	„
Basal breadth of last segment ..	2·25	„
Left Chela.—		
Total length of chela	10·6	„
Height of palm	6·3	„
Length of dactylus	7·2	„
Penultimate Walking Leg.—		
Length of merus	8·5	„
Breadth of merus	3·75	„
Combined length of carpus and propodus ..	9·0	„
Length of dactylus	4·5	„

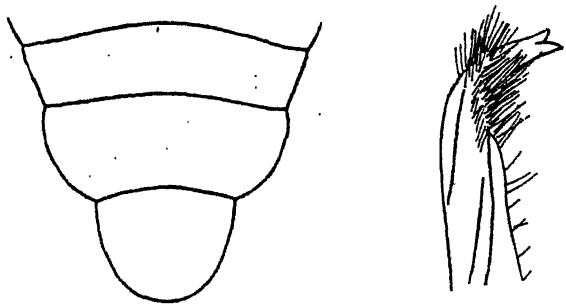
Sesarma penangensis sp. n. Fig. 10; Plate xxiv, 4.

Kemp, 1918, p. 240 (*Sesarma* sp.?).

Type.—A male from a stream on Penang Hill in the island of Penang, April, 1935.

Material.—The type and eight sub-adult and juvenile specimens from the type locality.

Description.—The carapace is slightly convex both transversely and longitudinally and is distinctly broader than long. The front is vertically deflexed but the margin is just visible when the carapace is viewed from directly above, as it is turned outwards and produced into two rounded lobes separated by a shallow median excavation; just inside the edge of each of the lobes is a transverse, rugulose ridge. Of the post-frontal lobes the outer are very small and, when viewed from the front can be seen to have their exterior portions turned downwards following the lateral margins of the front. The inner post-frontal lobes are fairly broad and separated by a wide median groove. The lateral margins are slightly divergent posteriorly. The tooth



a *b*

Fig. 10. *Sesarma penangensis.* *a*, outline of distal segments of male abdomen; *b*, right first pleopod of male.

at the antero-lateral angle is slender and sharp and separated by a rather deep gap from the epibranchial tooth, which is blunt and prominent and is raised distinctly above the level of the antero-lateral angle. Behind the epibranchial tooth the margin in the type is only slightly sinuous, but in the two largest paratypes this feature is sufficiently developed to be termed a rudimentary second epibranchial tooth, such as Kemp described in his specimen. The surface of the carapace is pitted but not granular or rugose. Apart from the triangular gastric area and a low, transverse emminence across the cardiac region, tubercles and ridges are distributed over the carapace as follows: a pair of tubercles just behind the outer post-frontal lobes, and another pair of smaller tubercles a little further back behind the inner post-frontal lobes; a ridge running obliquely inwards and backwards from a point just behind the rudimentary second epibranchial tooth; a short isolated ridge parallel to the last mentioned and situated behind its inner extremity; a strong oblique ridge just over the base of each of the last pair of legs.

The outline of the distal segments of the male abdomen is figured (fig. 10*a*) ; the anterior portion of the median impression in the sternal plate, which embraces the seventh abdominal segment (the sternal arch, c.f. Gordon, 1937, p. 152 and fig. 2) is bounded by a ridge which extends back to the anterior pair of sternal sutures, as in *S. maculata* de Man (Gordon, op. cit., fig. 2, d). In the male pleopod (fig. 10*b*) the chitinous projection is bifurcated at the tip.

In the chelipeds the merus and carpus are unarmed and the upper surface of the latter finely and sparsely granular. The chelæ are slender and have possibly not reached their full development in any of the available specimens. The outer surface of the palm is finely and sparsely granular and there are a few small granules at the base of the upper surface of the dactylus, which is otherwise smooth.

The proportions of the walking legs are not remarkable in any way; those of the penultimate leg are given in the table of measurements, the three distal segments of all the legs carrying fairly numerous long setæ and there are a few setæ at the distal end of the merus. The meri carry a blunt anterior sub-distal spine.

Although no females carrying the characteristic large eggs have been found, it is almost certain that *S. penangensis* belongs to the group of small, terrestrial species separated by de Man as a subgenus *Geosesarma*. Of these this is the third to be recorded from the Malay Peninsula. It differs from *S. foxi* as pointed out by Kemp (l.c.s.) and also in the form of the male pleopod (figs. 10*b*, 11). From the other Malayan species, *S. ocypoda* Nob. it differs by its much broader and less granular carapace, the presence of the definitely disposed tubercles and ridges

described and its broader and less deeply emarginate front. The walking legs in *penangensis* are stouter than in *ocypoda* and the row of spines on the dactylus of the chela of that species are absent in *penangensis*. The male pleopod also differs in the two species. That of *S. ocypoda gracillima* is figured by Gordon (1937, p. 154, fig. 4) and does not differ significantly from that of the typical form.

S. penangensis is nearest to *S. thelxinoë* de Man from the Andaman Islands, but differs conspicuously in the groove between the inner post frontal lobes, which is wide in *penangensis* and very narrow in *thelxinoë*.

Measurements of the type—

Carapace.—		
Anterior breadth	9	mm.
Posterior breadth	5	„
Length	8	„
Breadth of front	4·7	„
Abdomen.—		
Length (segments measured serially)	6·4	„
Breadth at third segment	5·2	„
Length of penultimate segment	1·3	„
Basal breadth of penultimate segment	3·2	„
Length of last segment	1·5	„
Basal breadth of last segment	1·75	„
Right Chela.—		
Total length of chela	5·7	„
Height of palm	2·5	„
Length of dactylus	3·2	„
Penultimate Walking Leg.—		
Length of merus	6·75	„
Breadth of merus	2·5	„
Combined length of carpus and propodus	7·3	„
Length of dactylus	3·9	„

Sesarma foxi Kemp. Fig. 11.

KEMP 1918, p. 238, Langkawi Islands.
LANCHESTER 1901, p. 550 (*S. maculata*).
TWEEDIE 1936, p. 52.

Material.—A male and an ovigerous female from the Larut Hills, Perak, 3,700 feet; two adult males, two females and two juveniles from Lacom, Peninsular Siam, collected by the 'Skeat' Expedition of 1899–1900 and erroneously determined as *S. maculata* de Man by Lanchester (l.c.). The two largest specimens of this series measure 11.7 (♂) and 11.0 (♀) mm. in anterior carapace breadth, and are the largest specimens of *S. foxi* so far recorded. For the opportunity of examining them I am indebted to the Directorate of the Cambridge Museum of Zoology.

Remarks.—The locality "Lacom" given by Lanchester is difficult to interpret precisely. It probably refers to Lakon, which is an alternative name for Nakon Sritamarat. Other records indicate that the species is montane in habit and the

'Skeat' specimens probably came from the hills a short distance inland from Nakon Sritamarat, which range up to a height of over 5,000 feet.

The right pleopod of the male from Perak is figured.

Fig. 11. *Sesarma foxi.* Right first pleopod of male.

Sesarma (Sarmatium) inermis (de Man), Cochin China and Condore Island.

DE MAN 1887, p. 660, 687.
TESCH 1917, p. 221.

Material.—One adult male, one sub-adult female and two juveniles from among nipah palms beside the river Sedili.

Remarks.—This appears to be a rare species and has not been recorded since de Man described the original series.

Measurements of the adult male.—

Anterior breadth	17	mm.
Greatest breadth	20	„
Breadth of front	10·2	„
Posterior breadth	10	„
Length	17·2	„
Length of chela	13·5	„

Sesarma (Sarmatium) punctata (A. Milne Edwards).

HELLER 1865, p. 64 (*Sesarma indica*), Ceylon, Nicobars..
A. MILNE-EDWARDS 1873, p. 308, New Caledonia.
TESCH 1917, p. 221.

Material.—Two adult males and seven females from a brackish swamp on Aor Island in the South China Sea.

Remarks.—A series of sketches of the type in the Paris Museum kindly made by Dr. I. Gordon leave no doubt of the identity of these specimens.

They were living in deep holes in the banks of a small stream near its entry into the sea and could only be collected at night; even then they were wary and difficult to catch.

In life the carapace is dark purplish brown irregularly marked with light brown near the posterior border. The legs are light brown with dark spots and the chelæ bright red.

The species is recorded from Ceylon, the Nicobar Islands, Sumatra, New Caledonia, and Japan.

Genus **Utica** White

Utica borneensis de Man. Fig. 12.

DE MAN 1895, p. 118, Pontianak, Borneo.
TESCH 1918, p. 95.

Material.—Three adult males and eleven sub-adult and juvenile specimens of both sexes from mangrove swamp near the mouth of the river Jurong, Singapore, July, 1934; one female from Prai, Province Wellesley, December, 1938.

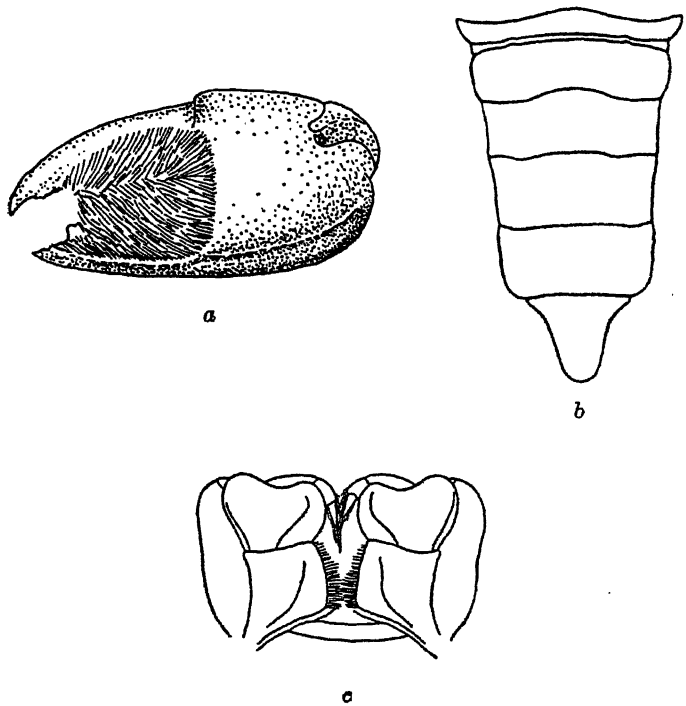


Fig. 12. *Utica borneensis.* *a*, left chela of male; *b*, outline of male abdominal segments; *c*, external maxillipeds.

Remarks.—This species was described from a single female from Pontianak, Borneo and has not been recorded since. As is usual in this and the allied genus *Ptychognathus* the male chela is very different from that of the female. In the present species the chelipeds of the male are equal and the length of the chela (fig. 12*a*) is about 2/3 the breadth of the carapace. The dactylus is rather strongly arched and the greater part of the

space between the fingers, both externally and internally, is filled with a mat of hair. On the propodus the extent of the hair is sharply bounded by a continuous curved ridge extending from near the dactylar articulation to the tip of the immovable finger. In addition a low, faint ridge runs along the lower part of the outer surface of the palm joining the curved ridge at the base of the finger. The upper surface of the dactylus is smooth and the outer surface of the palm slightly rugulose.

When the hair is removed from the chela the fingers are seen to be dentate distally, behind their horny tips, and at the base of the immovable finger, just below the dactylar articulation a curious, white fleshy protuberance is exposed. I can make no guess at its purpose, but it seems likely that it is connected with the presence of the dense mat of hair in the cleft of the fingers, as males of *Ptychognathus pusillus* have a similar protuberance that is quite invisible unless the hair is removed or parted.

The outline of the male abdominal segments is shown in fig. 12*b*.

The distinction between this genus and *Ptychognathus* is rather artificial, being based on the relative breadth of the ischium and exognath and the form of the merus of the external maxillipeds. In the present species the meri are distinctly auriculate and the exognaths only slightly narrower than the ischia (fig. 12*c*). It is thus intermediate between *Ptychognathus* and the more typically developed species of *Utica* such as *U. nausithoë* de Man and *U. gracilipes* White in which the exognath is very narrow and the merus more quadrate than auriculate in shape.

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EXPLANATION OF PLATE XXIV

1. *Sesarma moeschii* de Man, male from Johore.
2. *Sesarma sediliensis* sp. n., male cotype.
3. *Sesarma johorensis* sp. n., male cotype, x 2.
4. *Sesarma penangensis* sp. n., type, x 2½.

Planaires terrestres du Raffles Museum (deuxième note)

Par P. DE BEAUCHAMP
Professeur à la Faculté des Sciences de Strasbourg

Cette note fait suite à celle qui a paru dans ce Bulletin, n° 8, 1933. Comme l'indique la notice placée à la fin du n° 10, les figures en avaient été, par le fait d'un malentendu, beaucoup trop réduites, et les originaux en étant égarés j'ai dû les refaire et les publie à nouveau ici, en commençant par celle du *Bipalium admarginatum* de Beauchamp (pl. xxv) qui ne figure pas parmi les nouveaux matériaux.

Bipalium kewense Moseley?

Gunong Pulai, Johore, 4. 1934.—Un exemplaire brisé, environ 32 × 3 mm., non sexué.

Espèce d'une ornementation assez caractéristique, aujourd'hui cosmopolite dans les jardins et les serres; l'étude, qui a paru en 1939 des matériaux récoltés en Indochine française par Mr. Dawydoff m'a montré qu'elle est originaire de ce pays comme le soupçonnait von Graff.

Bipalium javanum Loman

Pulau Pisang, Malacca Str., I. 1934.—Un exemplaire de 50 mm. au moins.

Très disloqué et entortillé comme l'est habituellement cette espèce fort allongée. Il se peut que ceux que j'ai rapportés à *B. fuscatum* Stimpson dans la précédente note lui appartiennent également, mais le dernier montre sur fond sombre la bande claire médiane surchargée d'une mince raie noire qui est assez caractéristique de l'espèce. Son domaine s'étend de son île natale à Ceylan, Singapore, Siam (et Cambodge d'après les matériaux mentionnés plus haut). Elle semble aussi facilement importée, mais au voisinage de l'équateur.

Bipalium simrothi Loman. pl. xxvi.

Gunong Pulai, Johore, 1. 4. 1934.—1 exemplaire.
Pulau Pisang, Malacca Str., 1. 1934.—id.—.
Bukit Timah, 6. 1933.—2 exemplaires.

J'ai décrit dans ma première note plusieurs formes de cette espèce, qui n'a sans doute pas deux individus identiques. Ceux que j'y rapporte ici, bien que leur état de conservation ne se prête pas à vérification anatomique, appartiennent au type à

bandes transversales jaunes et noires. Les deux premiers (28 mm. × 6 et 13 × 5) ont 4 ou 5 bandes claires auxquelles s'ajoute une longitudinale formée de taches discontinues, l'un des derniers (11 × 5) en a 8, l'autre atteint 28 × 8, mais l'ornementation se voit mal car il a été desséché.

Bipalium wiesneri Graff. Fig. 1; pl. xxvii.

Gunong Pulai, Johore, 4. 1934.—Un exemplaire.

L'animal un peu courbé mesure environ 25 mm. sur 5 de large, la tête est proportionnellement grande (fig. 1), à la fois longue et débordante (7 mm. de large), les oreillettes très développées se recourbent en dedans de sorte que l'ensemble dessine un disque presque complet. La couleur est presque noire, il ne s'en détache qu'un cordon clair suivant à quelque distance le bord de la tête, et deux marques blanche transversales au niveau du pharynx (j'en avais d'abord noté deux autres paires qui paraissent s'être effacées). Les exemplaires de Graff (1899, pl. X, fig. 16–17) étaient un peu plus minces et moins foncés, surtout sur le vivant, et ne portaient qu'une raie claire médiane. Sur le ventre un peu plus clair la sole fait environ 1/6 de la largeur et porte elle-même en haut une traînée pigmentaire qu'a notée Graff.

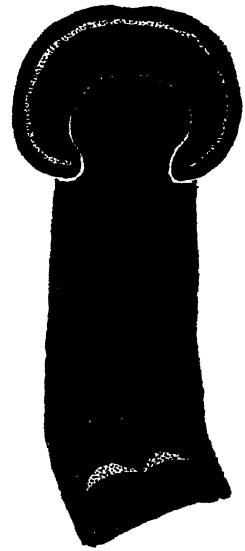

Fig. 1.—*Bipalium wiesneri*, extrémité supérieure, face dorsale, × 4.

L'un de ces exemplaires a été décrit anatomiquement par J. Müller en 1907, et les particularités très spéciales de l'appareil copulateur se retrouvent dans le nôtre: long organe ♂ terminé par un pénis proprement dit petit (ici un peu plus effilé et contourné, et terminé par un tube mince invaginé comme le flagelle de certains *Dendrocoelum*), sa lumière bordée de cryptes rectangulaires et alignées, formées par le plissement de son très mince épithélium; l'épithélium au contraire très haut et régulier figuré par M. dans la partie initiale où débouche un court canal déférent impair m'a paru n'être qu'une série de papilles régulières et parallèles chargées de petites cellules vésiculeuses. Autour une couche conjonctive, que M. croît musculaire; réciproquement la strate très dense et partagée en blocs qui la suit semble être formée de muscles circulaires peut-être involués. La masse périphérique consiste en fibres musculaires régulièrement entrecroisées et qui ne deviennent longitudinales qu'à la surface.

De même le conduit ♀ ventro-dorsal entouré à sa partie moyenne d'un sphincter circulaire et aboutissant à l'ootype proprement dit. Ici il est large et plat, en chapeau de champignon, recevant les oviductes à droite du sommet, et le conduit précédent très étroit s'infléchit pour venir y déboucher à gauche.

Tout ceci coïncide avec la description de M. à quelques détails près. Par contre une constatation importante est la présence de cryptes glandulaires dans le coussinet au centre duquel débouchent contigus les canaux ♂ et ♀. Il semble peu probable que cet auteur qui en a décrit d'analogues chez son *B. graffi* ne les ait pas vus dans son spécimen, où le coussinet paraît d'ailleurs beaucoup plus petit. Sans doute ne sont-elles bien développées qu'à maturité parfaite, ou même inconstantes comme parfois les organes musculo-glandulaires des Paludicoles. Il en existe 5 de chaque côté du plan médian, à peu près en cercle autour des orifices et de forme irrégulière. Chacune débouche dans une incisure de la surface par un canal oblique très fin qui s'élargit en un réservoir entouré d'une couche sans noyaux formée par l'extrémité des glandes finement granuleuses du parenchyme. De semblables débouchent d'ailleurs isolément sur toute la surface du coussinet, mêlées d'autres à sécrétion rouge homogène. Les fibres musculaires de celui-ci s'infléchissent autour des cryptes.

Bipalium graffi J. Müller

Bukit Timah, Singapore Isl., 11. 1933.—Un exemplaire.

L'animal mesurant 60 mm. sur 5 de large (corps) correspond parfaitement par son aspect et son ornementation à l'espèce de Bornéo connue par deux exemplaires, l'un décrit par Müller 1902, l'autre par moi, 1926, sans parler du *B. böhmigi* Müller certainement identique; la vérification anatomique m'a paru inutile. La teinte est gris foncé avec les 3 paires de marques

caractéristiques ivoire, dont la dernière se prolonge en raies longitudinales sur les côtés de la queue. Sur la tête, un bandeau réunit les 3 taches noires par en haut sans se confondre avec la bande marginale (il manquait aux anciens exemplaires).

L'extension de cette espèce de Bornéo à Malacca était intéressante à constater, d'autant que nous en verrons un autre cas. Du reste je ne doute pas que le *B. natunense* Meixner 1906 trouvé dans l'intervalle et dont l'ornementation est identique ne soit synonyme, et il en est peut-être de même du *B. megacephalum* Müller 1902 de Kwala Aring, Kelantan, à moins qu'il ne se rapporte à la précédente espèce, très voisine malgré son organe ♂ plus différencié.

Rhynchodemus sp.

Gunong Pulai, Johore 4. 1934.

Un exemplaire de 16×3 mm., assez plat, lancéolé, brun diffus, sole 1/3 de la largeur. Paraissait sexué, mais les coupes ont montré qu'il s'agissait d'un deuxième pharynx, accident de régénération sans doute.

Dolichoplana feildeni Graff

Fort Canning Road, Singapore, I. 1934.—Un exemplaire de 100 mm. environ.

Signalée dans ma première note et antérieurement, ubiquiste et banale. Mr. le professeur P. Remy m'en a récemment remis des exemplaires vivants recueillis dans le Jardin d'hiver du Muséum de Paris, et typiques bien que de petite taille. Elle est plus rare dans ces conditions en Europe que *Bip. kewense*.

Cotyloplana borneensis de Beauchamp. Pl. xxviii.

Gunong Pulai, Johore, 4. 1934.—Un exemplaire.

J'ai eu la surprise de retrouver là l'espèce décrite sur un individu unique dans ma première note. Celui-ci est plus grand (16 × 3 mm.) et plus foncé. L'appareil copulateur ne diffère que par des détails dans l'état de contraction: pénis plus long remplissant la plus grande partie de l'atrium, orifice de la bourse et de l'ootype plus profond, le recessus formant atrium ♀ (j'ai retouché dans ce sens le dessin que je redonne). C'est à cet ootype (plutôt que vagin) qu'aboutissent les glandes coquillières. Sécrétion bleue dans l'épithélium à l'entrée des atriums.

Pelmatoplana sp.

Gunong Pulai, Johore, 4. 1934.—Un exemplaire non sexué. Mesure 14 × 2,5 mm., aplati, effilé aux deux bouts, le supérieur bordé d'une rangée de petits yeux, teinte brun foncé, sole 1/8. Il est fâcheux qu'aucun *Rhynchodemus* ou *Pelmatoplana* de la région ne se soit trouvé sexué, car mon étude sur l'Indochine m'amène à des conclusions inattendues sur la répartition et les rapports de ces deux genres.....

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EXPLICATION DES PLANCHES

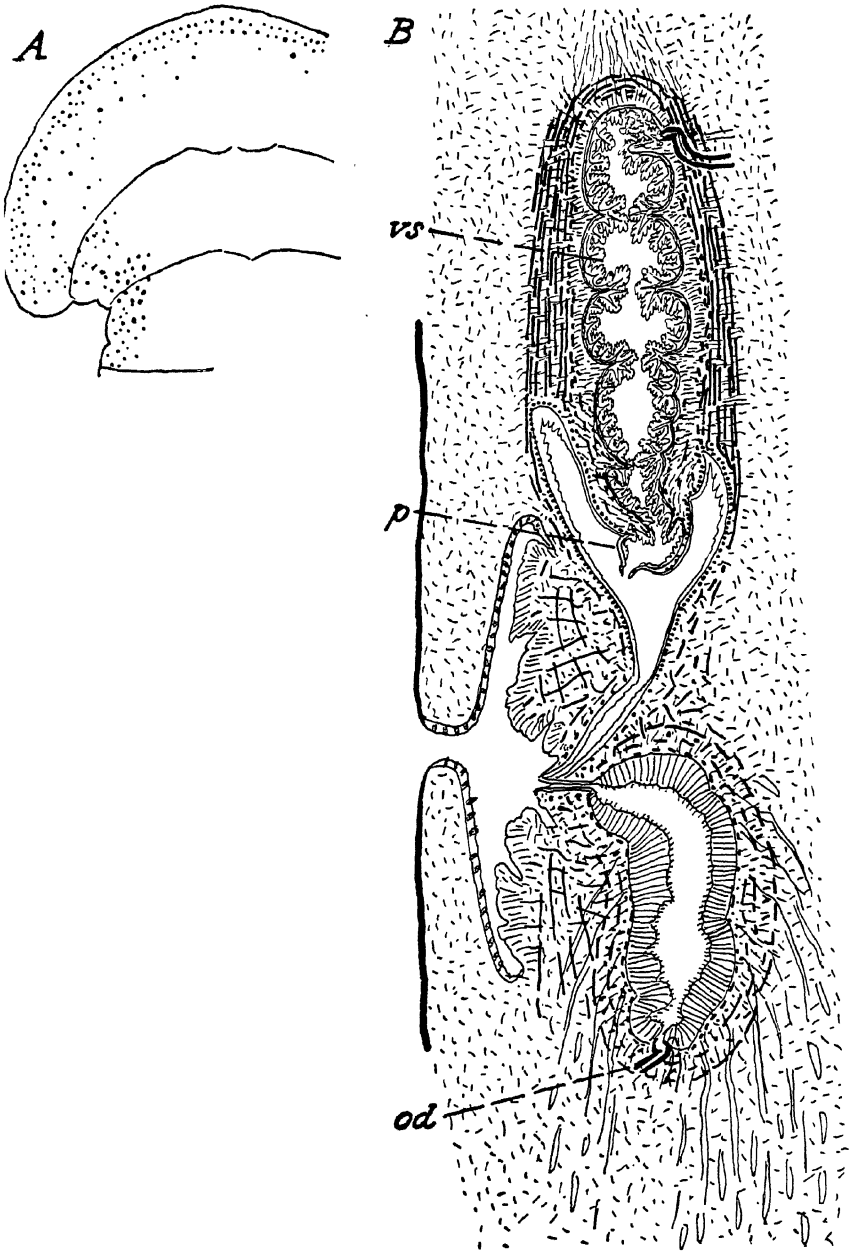
Pl. XXV.—*Bipalium admarginatum.* A, répartition des yeux à la face dorsale de la tête. B, schéma de l'appareil copulateur.

Lettres employées dans toutes les figures: *bc,* bourse copulatrice, *f,* flagellum du pénis; *g,* glandes de l'atrium commun; *od,* oviductes pairs; *og,* oviducte commun, ootype; *p,* pénis; *vs,* vésicule séminale.

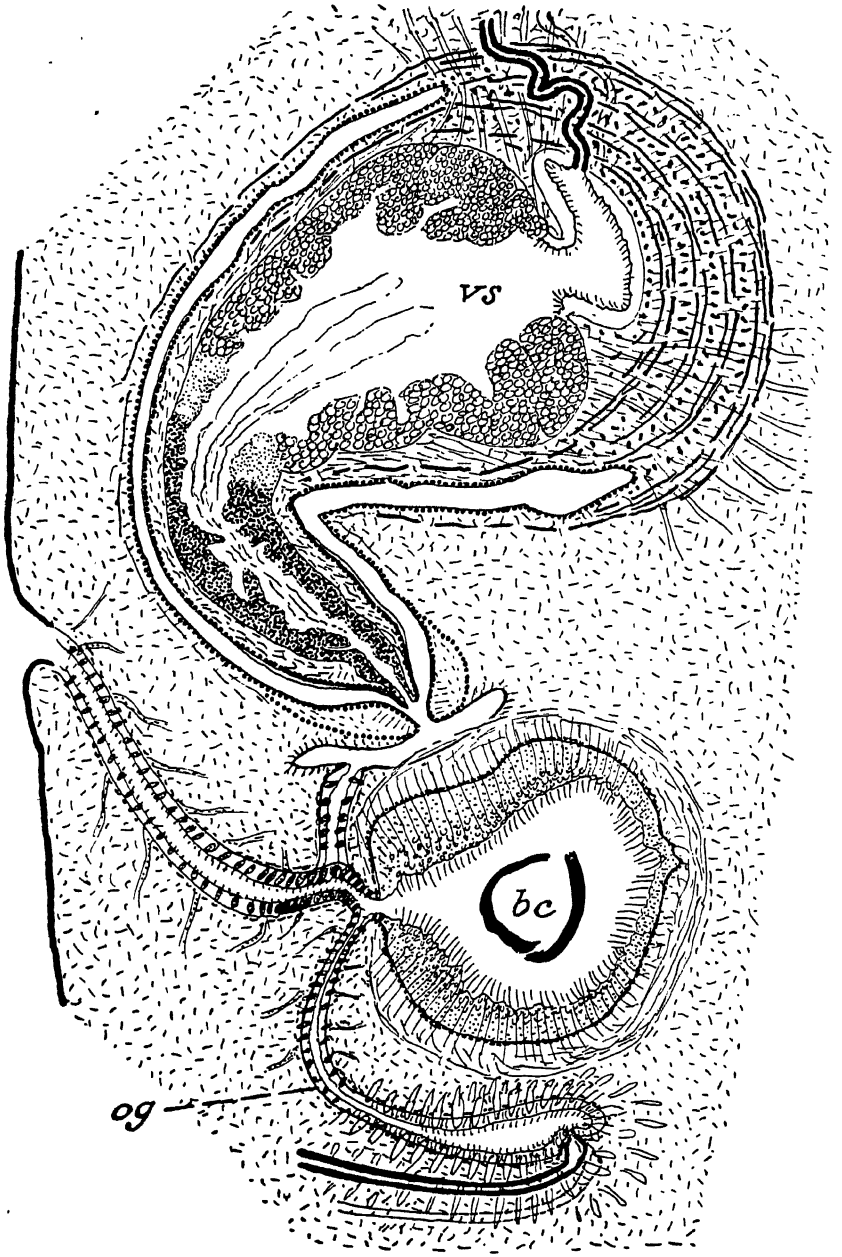
Pl. XXVI.—*Bipalium simrothi,* schéma de l'appareil copulateur (individu d'Aor); l'atrium ♂, l'oviducte et la bourse copulatrice, qui devraient à peu près se superposer en vue de profil, ont été écartés.

Pl. XXVII.—*Bipalium wiesneri,* schéma de la partie inférieure de l'appareil copulateur; les cryptes glandulaires ne sont pas en réalité dans le plan sagittal médian.

Pl. XXVIII.—*Cotyloplana borneensis.* A, tête, face ventrale. B, schéma de l'appareil copulateur. Les petits chiffres indiquent les segments successifs du canal éjaculateur.



Planaires terrestres de la Péninsule malaise.



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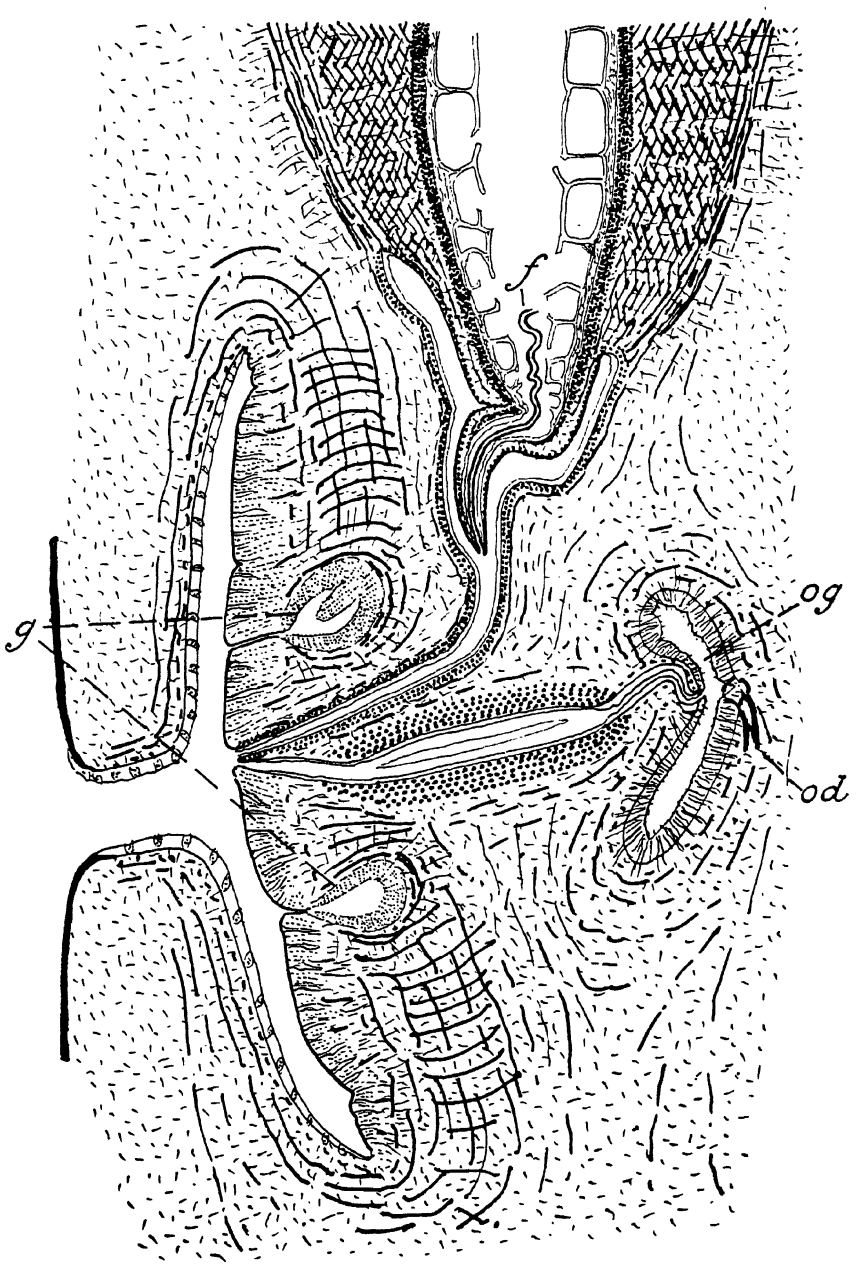

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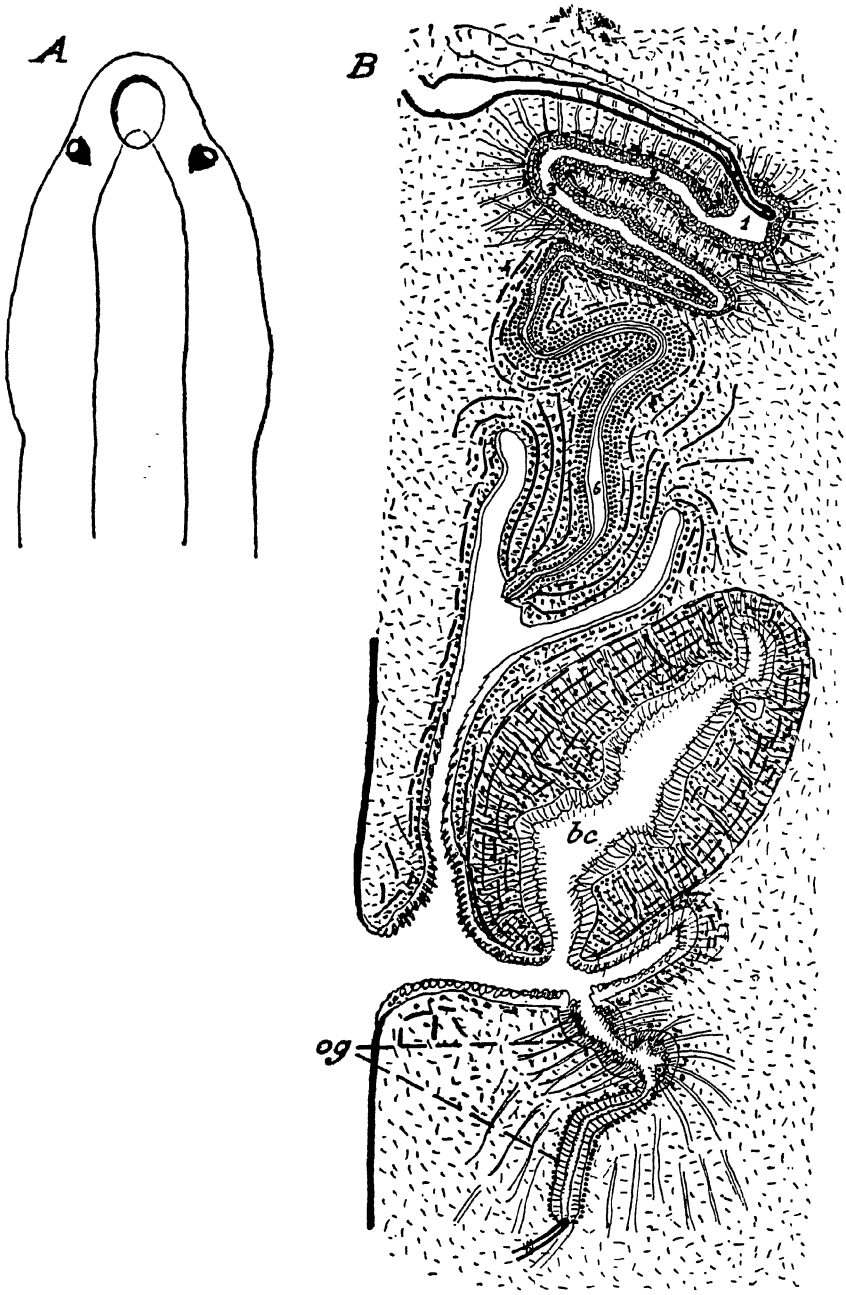


Planaires terrestres de la Péninsule malaise.

On a new species of the genus Corbicula Meg. von Mühlfeldt from northern Perak

By B. PRASHAD, *D.Sc., F.R.S.E., F.R.A.S.B., F.N.I., F.L.S., F.Z.S., M.B.O.U., Director, Zoological Survey of India, Indian Museum, Calcutta*

PLATE XXIX

Sometime back Mr. M. W. F. Tweedie of the Raffles Museum, Singapore, kindly sent me for identification two specimens of a species of the genus *Corbicula* collected from Chenderoh near Lenggong in Northern Perak. The specimens did not agree with any of the species of the genus from Siam and the Malay Peninsula[1], and I, therefore, requested Mr. Tweedie for a larger series of the species to be collected for further study. He could not obtain more material from the original locality, but sent three more specimens which he had kept at Singapore. A careful examination of the five specimens leaves no doubt that they belong to a new species which I associate with the name of Mr. Tweedie and describe below as *Corbicula tweediei*, sp. nov.

Corbicula tweediei, sp.nov.

Species of a fair size, thick-shelled, subtriogonal, markedly inequilateral, greatly inflated in the umbonal region, much compressed in the posterior and lower half of the valves; young shells trigonal, subequilateral, adults with the anterior side shortened, and posterior drawn out into a prominent broad beak, the outline of the beaks varies considerably even in the small series of specimens before me, being either broadly rounded or truncate; shells shining brown to blackish in colour. Upper margin short, moderately arched; anterior side short, slightly arched, evenly rounded; posterior side elongate, almost straight, ending in a rounded or truncated beak, ventral margin moderately arched; lunule not marked; escutcheon ovoidal; umbones very prominent, large, tumid, curved inwards, almost meeting in the middle line; in older shells greatly corroded and almost without sculpture. Shell surface covered with concentric, very regular, only slightly raised and thickened ridges in young and half-grown shells, in full-grown shells the ridges on the beak and lower one-third of the shell are finer, more closely placed and somewhat irregular; ligament very thick and prominent. Hinge normal, well developed; posterior cardinals much longer than anterior,

1. *See* Prashad, B.—*Mem. Ind. Mus.* IX, pp. 30–35 (1929).

almost straight; pallial line distinctly marked, slightly angulate posteriorly; muscle scars slightly impressed. Nacre bluish-violet, lighter below the umbones, in adult shells dull whitish.

Measurements (in millimetres)

	Holotype				
Length ..	39·3	37·2	36	33·3	27
Maximum Height	34·2	34	30	29·4	25·6
Thickness ..	21·9	23	20·3	19·8	16·8

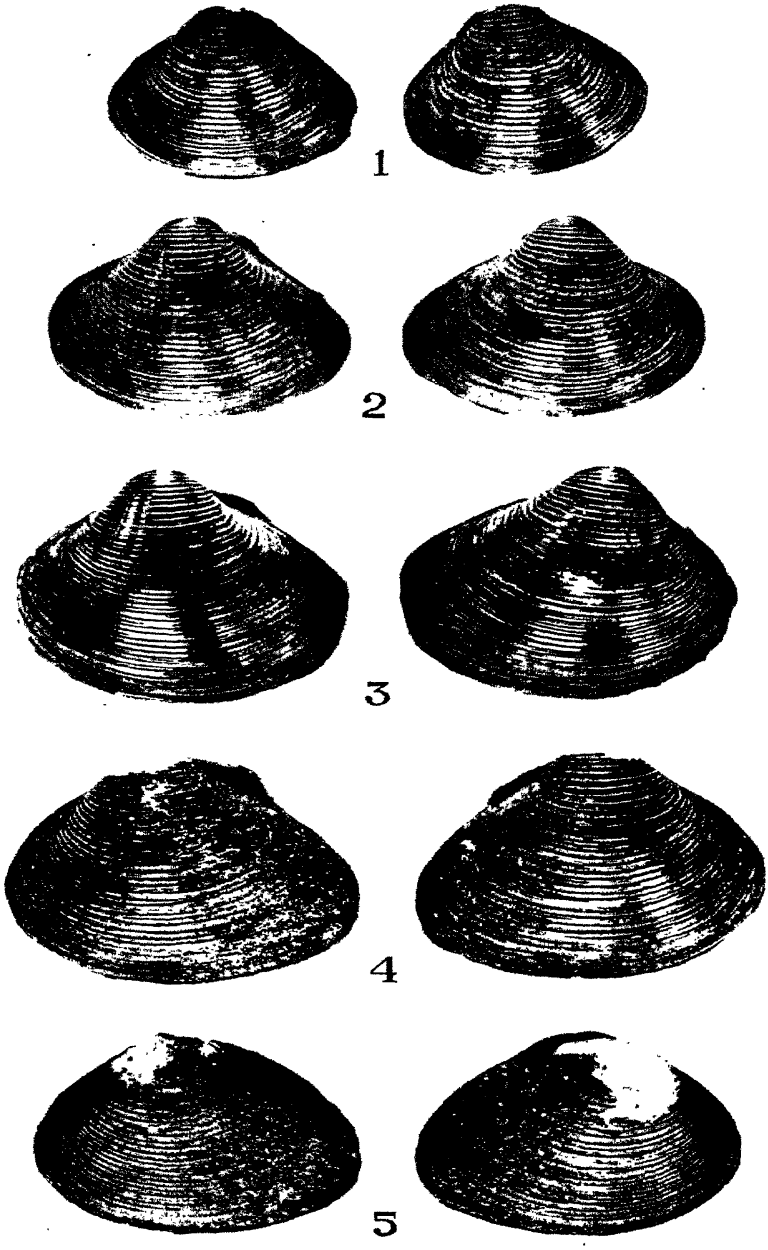
Distribution.—The five shells on which the above description of *C. tweediei* is based were collected at Chenderoh Dam, near Lenggong, Perak River Valley, Northern Perak, Federated Malay States, during February–March, 1937.

Remarks.—*C. tweediei* is allied to *C. bandoni* Morlet[1], but is easily distinguished by the shape and sculpture of the shell.

Explanation of Plate XXIX

Corbicula tweediei, sp. nov.—Figs. 1–5. Direct photographs of a series of five shells from Chenderoh Dam. No. 4 is the Holotype.

1. *See* Prashad, B.—*Mem. Ind. Mus.* IX, pp. 35, 36, pl. v, figs. 15–19 (1929).



Corbicula tweediei n.sp.

Notes on some specimens of the genus Atopos (Mollusca Pulmonata) with microphotographs illustrating points in the anatomy of the genus

By F. F. LAIDLAW

PLATES XXX–XXXIII

This account is based on specimens sent me from the Raffles Museum, Singapore, and on a fine example of *maximus* Collinge lent me by Mr. Forster-Cooper, then Curator of the University Museum of Zoology at Cambridge.

Material.—Two individuals "from limestone hill, near Baling, Kedah". These are similar to the form described as *sarasini* Collinge 1902.

The larger specimen is 70 mm. in length, the smaller 50 mm. Sections were cut from the smaller specimen. Sent from the Raffles Museum.

One specimen from the Cameron Highlands, Pahang. 40 mm. in length. Not unlike the above, but grey-black, rather than blue, and with the foot-sole pigmented, of the same colour as the rest of the body, but rather paler. Sent from the Raffles Museum.

One specimen from Gunong Pulai, Johore. Length 50 mm., greatest height 8 mm. breadth 6 mm. Very like the type of *laidlawi* Collinge 1902 but without a dark, dorsal band. Sent from the Raffles Museum.

One specimen from Bukit Besar in Jalor. Coll. N. Annandale. This is an example of *maximus* Collinge 1903*a*. From the University Museum of Zoology, Cambridge.

I wish to give my best thanks to the Director of the Raffles Museum and to Mr. Forster-Cooper for allowing me to examine these very interesting creatures.

I have to thank Col. Peile for notes on the radula of one of the specimens, which he was good enough to mount for me, and for photographs and figures of the same.

I am also indebted to Mr. J. T. Wadsworth of the Zoological Dept. of the University of Manchester for sections. These were cut serially, in a plane transverse to the long axis of the body, from a specimen embedded in collodion, and are 90 μ thick.

Unfortunately the front end of the specimen is strongly ventriflexed, as is so often the case in preserved specimens, so

that the plane of the sections varies towards the front of the body, making any reconstruction very difficult. In addition the radula is partly protruded.

The sections were stained with borax-carmine.

I have retained the generic name *Atopos* as a matter of convenience; to judge from Rathouis' account and figures there is little of generic value to distinguish Heude's *Rathouisia leonina* from species of *Atopos*.

The family name must stand as *Rathouisiidae*, as *Rathouisia* was the first genus to be distinguished (Heude 1884).

Its distribution is interesting. Species have been recorded from South China, Burma, Siam, Malaya, and all through the Sunda Archipelago to New Guinea and N. Australia. No representative has been recorded from any other Zoogeographical Region.

Certain sub-genera (or genera) have been defined for species of the genus.

These are:—

Prisma Simroth 1891.
Padangia Babor 1900. (=*Podangia* Ghosh 1913).
Parapodangia Ghosh 1915.

I agree with Hoffmann in thinking that the single genus *Atopos* (or *Rathouisia*?) may include all the known forms.

Hoffmann has also put down a number of the described species as synonyms. I cannot give an opinion of any value on this matter.

The present paper records specimens of *Atopos* from Pahang, Johore and Kedah for the first time.

From Kedah and Jalor I am able to record *sarasini* Collinge. Hoffmann regards *harmeri* Collinge as synonymous, and further looks on both as identical with *tourannensis* (Soul.) from Cochin-China. The small specimen from the Cameron Highlands (Pahang) whilst showing some differences, is in general very similar.

Collinge's species *laidlawi* is known from Jalor and Johore and is looked on by Hoffmann as the same species as *pulverulentus* (Benson) and *sanguinolentus* (Stol. MS.) Ghosh. both from Penang. Here too *fide* Hoffmann is to be referred *strubelli* Collinge (nec Simroth), from Jalor.

Both *maximus* Collinge and *rugosus* Collinge are admitted by Hoffmann; both are from Jalor.

Lastly *punctatus* Collinge from Jalor is said to be a synonym for *cristagalli* Saras. from Celebes.

There are therefore some five distinct forms of this genus in Malaya, possibly more, and it is evident that they are widely if sparingly distributed. A knowledge of their habits may show that they are not so rare after all.

Rathouis (1884) has given a graphic account of the habits of the species discovered by him in the Yang-tze valley and named *leonina* by Heude (1884). He found that it hid itself when the weather was dry or cold, but did not choose very damp situations; it was found most abundantly in crannies of old brick walls. "It preys on other molluscs, for choice a *Succinea*. It worries "its victim until it induces it to withdraw into its shell, where- "upon it proceeds first to suck away any mucus secreted by it, "and then to absorb little by little the tissues of its victim through "its proboscis, the whole process taking from 20 minutes up to "two hours or even longer, according to the size of the animal "attacked".

Rathouis writes that he has found the entire body of a snail so devoured in the stomach of *Rathouisia*. Such a meal is sufficient for two or three days. He has detected the radula and jaws of the prey in the fæcal bolus of the slug, along with small living nematodes.

He describes also the mating of *leonina*. This takes place at the end of April or early in May. For some time before pairing less food is taken. (This observation bears on the condition of the specimen of *maximus* that I have examined, where the great enlargement of the albumin gland has compressed the liver and almost obliterated the cavity of the stomach).

Whilst mating the two individuals take a position almost foot to foot, ("un peu rétournes et presque pied a pied. Il ne parait rien en dehors; les pénis seuls sortent pour pénétrer directement dans les vagins).

Pairing begins early in the morning and lasts most of the day. The eggs are laid about a month later, usually in one or two "paquets". The young slugs emerge from the eggs after some three weeks; they feed first on "albumine sécrétée par les microphytes" and on mucus from the tracks of other molluscs.

Rathouis states that so far as possible he observed the slugs in their natural surroundings, but that he had further reared and fed slugs in glass cages.

Similar study of the methods of obtaining a livelihood employed by Malayan species would be sure to be full of interest.

The big foot-sole of *Atopos* (and of *Rathouisia* suggests that the the animal is an active crawler. Most preserved specimens show some degree of ventriflexion, I have not seen any that have lateral flexion. Perhaps the power of lateral bending is not much developed in the living animal.

The colouring and texture of the body have been compared to that of *Peripatus* (Annandale, in Collinge 1903) with justice, and the shading off of the colour on the edge of the notal flap

as for example in *maximus* may give some resemblance to the legs of *Peripatus* especially when the animal is moving.

Annandale (loc. cit.) has noted that the Malays call these slugs by the same name as they use for *Peripatus*, and regard them as very poisonous. (See also Gimlette: Malay Poisons and Charm Cures).

Two specimens of Atopos were recovered from the stomach of the snake *Boiga dendrophila* (Boie) by Annandale.

The Rathouisiidæ may be reckoned as one of the groups of very primitive creatures that have survived in Malaya and neighbouring lands. With the Onchidiidæ and Veronicellidæ they form a distinct group remote from all other Pulmonata. In certain important respects they are more primitive than the two families associated with them. The position of the opening of the cloaca, and the presence of paired head glands (Simroth glands) give the Rathouisiidæ a right to stand apart from the others, whilst the proboscis and lack of jaw are specializations in accordance with the carnivorous habits of the animals.

(The curious white head and tail of *laidlawi* may serve to break the outline of the body, and give it some resemblance to a bit of stick or some other jungle debris).

External characters.—The body is long, pointed at both ends, and triangular in cross-section. The apex of the triangle is made by a keel which runs the whole length of the dorsum, the base by the foot-sole. The sides are formed by the 'notum' which slopes down on either side from the keel. The foot is separated from the notum by a deep groove on either side, the free edges of the notum making a flap which hides the foot when the animal is crawling in a natural position.

The foot is wrinkled transversely and extends for the whole length of the body, except for a small pyramidal space at the front, into which the head can be withdrawn.

The head itself is small, the tentacles non-retractile. The upper pair are finger shaped, each carries a well-developed eye (pl. xxxiii, 2). The lower pair are bilobed, flattened laterally, lie somewhat obliquely, and are well supplied with sensory organs.

Integument.—The skin covering the notum is thick and leathery, richly pigmented, and free from adherent mucus. It is granular in texture, with a large number of small tubercle-like processes dotted about irregularly. In some species these are coloured differently to the general body-surface. Thus in *maximus* the colour is gray as a whole, the tubercles are sooty black. In section these tubercles stand out well from the surface. The sections are too thick to allow of detailed study of their structure.

The deeper part of the skin is much vacuolated, and under the dorsal keel the vacuoles are enlarged and form a definite areolar tube, co-extensive with the keel itself.

Below this vacuolated layer lies the muscle layer of the body-wall. The innermost fibres of this are mainly circular, the outer fibres are radial and longitudinal.

Ventrally this muscle layer coalesces with the musculature of the foot, forming a long tube narrowing at each end, and entirely enclosing the internal organs of the body, except in front where it gives place to the structures forming the head.

This tube is pierced by the rectum, the pneumopore and nephropore, all on the right side of the body, at about the end of the first fifth of the body-length. These all open close together into the top of the groove separating the notal flap from the foot; and at a slightly lower level, and separated from them by a ridge the female gonopore also opens.

The penile opening is on the right side of the head, whilst the right and left Simroth glands (when the latter is present) open into the pyramidal space just at the base of the lower pair of tentacles.

In addition the pedal gland opens in the middle line on the very front of the sole. (In the specimen from the Cameron Highlands the front end of this gland is actually everted; whether this can occur in a living specimen I do not know).

A number of bilaterally symmetrical, vascular sinuses run in the musculature of the foot and body-wall.

On the floor of the body cavity several strands of muscle diverge backwards from a muscular 'knot' which lies below the level of the retracted radula-sac. These strands unite with the musculature of the foot. Ghosh (1913) suggests that they are the homologue of the columellar muscle of other molluscs.

Alimentary canal.—The mouth is without jaws. The pharynx is continued back into an eversible radula-sac, and the whole of this part of the canal has when retracted the appearance of a narrow amphora with one handle, represented by the gullet. The base of the amphora is attached to a slender cord, perhaps a protractor muscle. This runs forward below the sac and is attached to the ventral body wall in front of the circum-œsophageal nerve ring. Along this cord pass the connectives of the buccal ganglion.

Many spirit specimens show the radula-sac or proboscis at least partly protruded. It is a small cylindrical tube, projecting from the mouth, about 5–7 mm. in length.

The pharynx is very muscular; bundles of longitudinal fibres can be seen almost completely surrounding it. These no doubt assist in the sucking process described by Rathouis. The radula-sac is separated from it by a narrow neck, on it I have not found any longitudinal muscles.

(Note by Col. Peile)

"The radula figured, from one of the Kedah specimens of "'*sarasini*' measures 6.5 × 1 mm. when flattened out. It has "about 50 V-shaped rows of formed teeth with formula 21-1-21. "The outer lines in the front rows are missing owing to use, "the radula is therefore rounded in front. The central and "outermost marginal are vestigial and absent in some rows. The "rest of the teeth are aculeate, subequal in lines 1 to 10 and the "area of attachment to the basal membrane is about the length "of the tooth. In the outer lines the teeth diminish in size while "the area of attachment gets smaller in proportion to the length "of the tooth. The outline of the junction with the base, as seen "through the transparency of the tooth is evidently what is "referred to by Ghosh (1913), as 'cuplike process' or 'crescentic "notch.'"

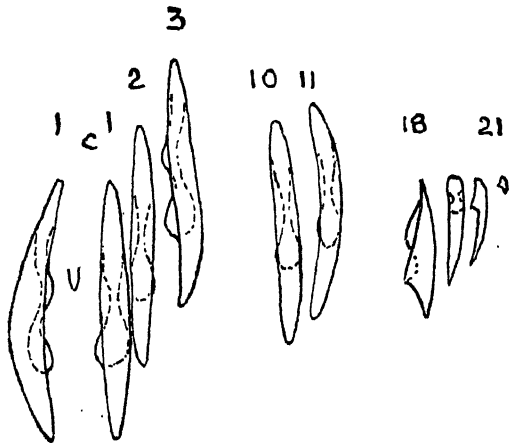


Fig. 1. *Atopos sarasini.* Drawing of individual teeth from radula figured on pl. xxxiii, 1.

The gullet starts from the dorsal side of the pharynx at the point where this passes back into the radula-sac. Because of the presence of this sac the gullet cannot run directly down to the nerve ring, but passes (when the sac is fully retracted) first to one side, then forward, and then turning down it hooks back through the nerve ring, and is continued back towards the hind end of the body, lying a little to the right of the middle line. It is very slender and has thin walls, its free part in front of the nerve ring no doubt allows it freedom of movement for the protrusion of the radula-sac. As it passes back it lies below the salivary glands and the pedal gland. When it reaches the

liver it passes for some distance under that organ, then turning up it finally opens into an irregular chamber in the substance of the liver itself.

The large liver generally fills up the hinder half of the body cavity, and conforms in shape to it. Its outer wall is smooth, and the whole organ has a characteristic yellow colour. It has a large central cavity into which opens a large number of crypts. These openings give the central cavity a certain resemblance to the '*reticulum*' of a ruminant. The central cavity and the crypts are lined with columnar epithelium which has a granular protoplasm the nuclei being indistinct, and the protoplasm rather vacuolated at the base. The epithelium rests on a basal membrane.

The liver cavity is continuous with that into which the gullet opens. This latter space, the mid-gut, can be distinguished in section by the character of the epithelium lining it. This is columnar, with hyaline protoplasm and very well-stained nuclei.

At about the level at which the gullet passes into the mid-gut the rectum opens from the latter. It lies first on the left side of the liver, then after running back a short distance turns upwards and crosses over the dorsal surface of the liver, embedded in it to some extent, and finally on the right side of it becomes a narrow, free tube which runs to the body-wall on the right side, ending by opening into the cloaca.

During its course in the substance of the liver the rectum has a wide lumen, and it is in this part of the alimentary canal alone that I have seen any trace of food material. The nature of this cannot be determined from the sections.

The lining epithelium of the rectum is similar to that of the mid-gut except for the last part of its course where its walls become muscular and the lining epithelium flattened.

Pallial complex.—This lies dorsally, close under the body-wall at about the end of the first quarter of the body length. As a whole it is circular in outline, and conforms to the curvature of the body-wall lying over it so that in transverse section it shows as an arch, lying above the anterior end of the liver, between that organ and the liver itself. (pl. xxxii).

The kidney is the largest single organ in the complex. Seen from above it is almost semilunar in shape, the two horns projecting forward, so as to enfold the pericardium in the middle line, whilst the right horn is encroached on by the lung. Its structure is that of a spongy reticulum, the cells bounding the numerous spaces of the network contain numbers of minute, refringent granules, which give the organ a characteristic appearance in sections. These cells are rather flattened, and lie on a basal membrane. The ureter rises at the hinder part of

the right side of the kidney and runs forward and downward, against the inner surface of the lung, to open close to the end of the rectum in common with the latter, by the cloaca.

The lung lies on the right side of the complex, and does not extend so far back as the kidney. Its walls are folded to some extent but there is no dense reticulum such as occurs in the kidney and the flattened cells lining the walls are entirely devoid of refringent granules. A little way back from the lung opening there is a marked thickening of the lower part of the wall of the lung on its outer side. This thickened part is folded so as to make a sort of pocket which extends back to the hind end of the lung. No nerve has been traced to it, and its function is unknown. The lung opening (pneumopore) lies just behind that of the cloaca, and immediately above that of the vagina (pl. xxx).

The pericardium lies immediately below the dorsal sinus, in front of the concave anterior margin of the kidney and is partly enfolded by it. The reno-pericardial canal opens into the pericardium from behind almost in the middle line. The auricle lies to the left of the space, the ventricle to the right. This latter is directed to the right and forward. From its anterior, outer end the short aorta continues in the same line for a short distance, and then divides into anterior and posterior branches. The former runs towards the front end of the body, close along the œsophagus, as far as the nerve ring; the latter passes back into the liver running for some distance below it and giving off branches to the hermaphrodite gland.

The appearance of the cavity of the ventricle has been figured by Ghosh (1913). Our sections show a very similar condition. (pl. xxxi).

Reproductive organs.—The account below is of the large specimen of *maximus* from Bukit Besar, Jalor. This individual was fully mature sexually. The example figured by Collinge was not so mature, but on the whole his account agrees with what we found in the riper specimen. The hermaphrodite gland has been pushed to the extreme hind end of the body-cavity. It consists of a number of closely packed follicles which are very friable. The hermaphrodite duct runs from it as a convoluted tube into a mass of tissue which consists of a mucilaginous core, surrounded by a cortex of orange coloured material. The whole swelled up so much when the specimen was put in water for dissection that it is quite impossible to distinguish any structure in it. The cortex has the consistency of a Dutch cheese and a similar colour. Presumably the genital duct runs as a convoluted tube through this structure which is called by Collinge the albumen gland. In our specimen the gland has a length of about 40 mm. At its front end, and pressed closely against it is a smaller body, measuring about 10 mm. of a pale yellow colour and of a firmer

character which is probably a prostatic gland. The oviduct and vas deferens leave the mucilaginous gland, which passes forward a short distance below the 'prostate' at the anterior end of the former.

The oviduct is a short stout tube, which runs forward and outward to the right to pass into the body-wall, through this of course it opens immediately by the female gonopore. Just as it passes into the wall it receives the opening of the receptaculum seminis, a short, stout tube which is rather club-shaped, and nearly as long as the free oviduct.

The vas runs into the body-wall close in front of the oviduct, and runs forward in the wall, along the right side of the foot, just beneath the epidermis. Simroth (1891), has figured a section of the foot showing its position. It travels forward as far as the pyramidal space and then re-enters the body cavity.

Its position is indicated in the photograph of the section figured (pl. xxx) though it does not actually lie in that section. On passing again into the body it runs as a fine convoluted duct along the penis, passing into its upper end. It is a muscular organ, about 12 mm. long in our specimen of *maximus*, enclosed in a sheath, to which it is attached at its upper end. The inner wall of the sheath, which permits the protrusion of the penis, is slightly folded into a number of longitudinal plicae, the upper end is fastened to a retractor muscle, which passes back into the musculature of the body-wall.

Rathouis did not interpret his dissection of the genital apparatus correctly. He took the R. Simroth gland to be the testis and seminal vesicle, and the vas where it is attached to the penis he labelled the flagellum. Later writers too found the interpretation of these structures difficult, though they were clearly described and figured by Simroth (1891).

(*Note.*—In this individual the hinder part of the liver was flattened and displaced by the great development of the hermaphrodite duct and associated structures. In fact the hinder half of the liver was reduced to a thin sheet of pigmented tissue, lying above the duct. Nothing like this was found in other specimens, nor anything comparable in figures given by other authors. In contrast the whole of these structures, the hermaphrodite gland its duct and prostate, in the specimen from which sections were cut have a total length of about 6 mm. The specimen is of course sexually immature).

Simroth glands.—These are either present as a fully developed pair, or the left is entirely absent.

The glands are paired in *maximus*, in the specimen of *sarasini* from which the sections were prepared, and in *australis*.

Collinge found them unpaired (*i.e.* Right gland present only) in his specimen of *sarasini*, Ghosh notes that they are

unpaired in *gravelyi, kempi,* and *aborensis.* I found the gland unpaired in the specimen from the Cameron Highlands.

The gland consists of a coiled secretory part, a narrow rather convoluted tube with a layer of cubical epithelium; this is followed by a long, convoluted conducting part, slender and thread-like; lastly there is the ejaculatory part, a small spindle-shaped structure, with muscular walls.

The right Simroth gland must be homologized with the dart-sac of other land-molluscs. The fact that these glands are paired, in some species at least, suggests that primitively this organ was not connected with the reproductive apparatus, this latter being essentially unpaired in the Pulmonata.

Central nervous system.—The ganglia are concentrated and connected by stout short commissures leaving only a very narrow ring for the passage of the gullet and salivary ducts.

The plane of the circumœsophageal ring is oblique, so that the cerebral ganglia lie in front of the subœsophageal ganglia but almost on the same horizontal level. The buccal commisures on the other hand are long and slender, and run along the lower surface of the radular sac to the small buccal ganglia. From the cerebral ganglia also run large nerve trunks to the labial palps, tentacles, and muscles. The other ganglia are so closely connected that it is difficult to distinguish them externally. Odhner's account (1917) may be quoted. "The posterior half of the nervous ring is occupied by the parietal ganglia, which send nerves to the penis, and the musculature of the body sides. A very inconspicuous pleural ganglion exists between (each of) them and the cerebral centre. At the hindermost side of the ring, between the parietal ganglia, a very indistinct visceral centre is recognized by the visceral nerve that emanates here near the right parietal ganglion, and follows the intestine backwards, till it ramifies in the hermaphrodite gland and the liver.

The whole underside of the posterior portion of the nerve centre is occupied by the elongated pedal ganglia. From their anterior end they send nerves to the pedal gland, and from the posterior end of each a very strong nerve cord stretches back innervating the foot and hyponotum.

Sense organs.—The eyes are well developed as might be expected in a predatory form (pl. xxxiii, 2). The lower pair of tentacles, or palps, are richly supplied with nerves, and the appearance in section suggests that they are sensory. The central part of either palp is traversed by nerve tissue, which as it approaches the margin of the palp radiates fan-wise, each branch running into a paired column of small, darkly-staining cells, the columns lie at right angles to the margin of the palp, and in every case are in pairs, each pair uniting at its base, where it is

entered by the nerve, and each pair having a slight enlargement near the base. The whole series may be likened to a series of tuning forks, lying side by side.

Rathouis (1884) figures otocysts from the species *leonina*. Odhner (1917) did not observe any such structures in *australis* Heyneman. Owing to the thickness of my sections, and to the curvature of the head end of the animal I cannot be sure of their presence.

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(Dr. Th. Mortensen's Pacific Expedition 1914–16).

Explanation of lettering in plates XXX, XXXI and XXXII.

Ar.	Artery.
Cl.	Cloaca.
D.S.	Dorsal sinus.
G.	Genital glands.
H.	Liver.
L.	Lung.
Musc.	Muscles.
Nep.	Kidney.
N.F.	Notal flap.

Oe.	Oesophagus.
Ov.	Oviduct.
P.	Pericardium.
Ped.	Pedal gland.
Pn.	Lung opening.
P.C.	Reno-pericardial canal.
R.	Rectum.
Sal.	Salivary gland.
V.	Vagina.
Vasc.	Vascular sinus.
Ven.	Ventricle.
X.	Thickened wall of lung.
Z.	Position of vas deferens in its course in the body-wall.

Explanation of Plates

Atopos sarasini Collinge

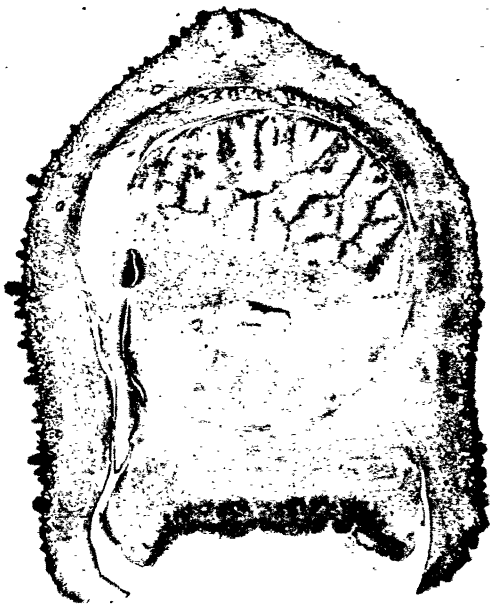
Plate XXX. Microphotograph of section through the body at level of the opening of the pneumopore and vagina.

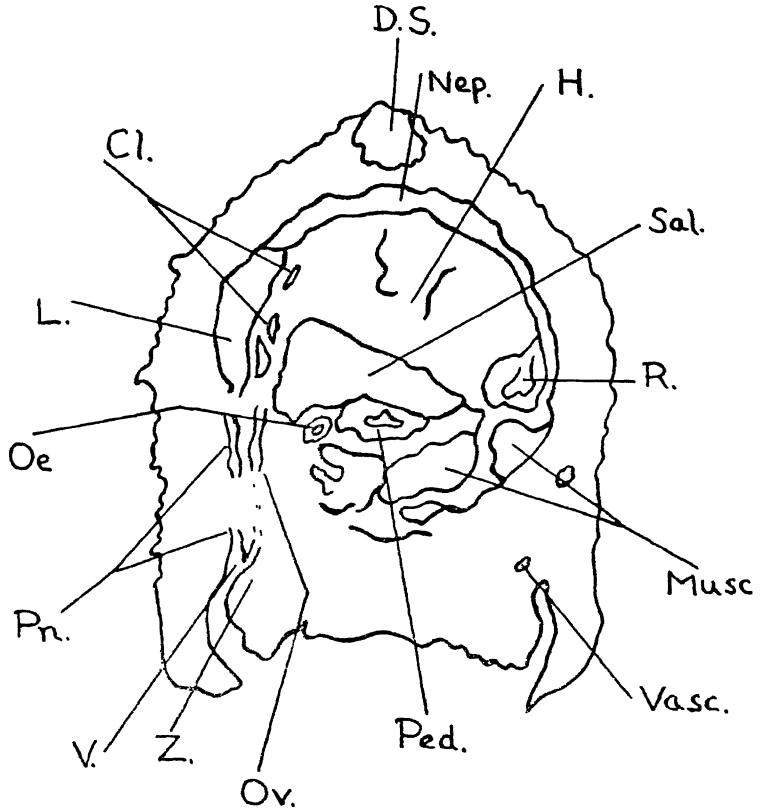
Plate XXXI. Microphotograph of section through the heart and pericardium.

Plate XXXII. Microphotograph of section shortly behind the pericardium.

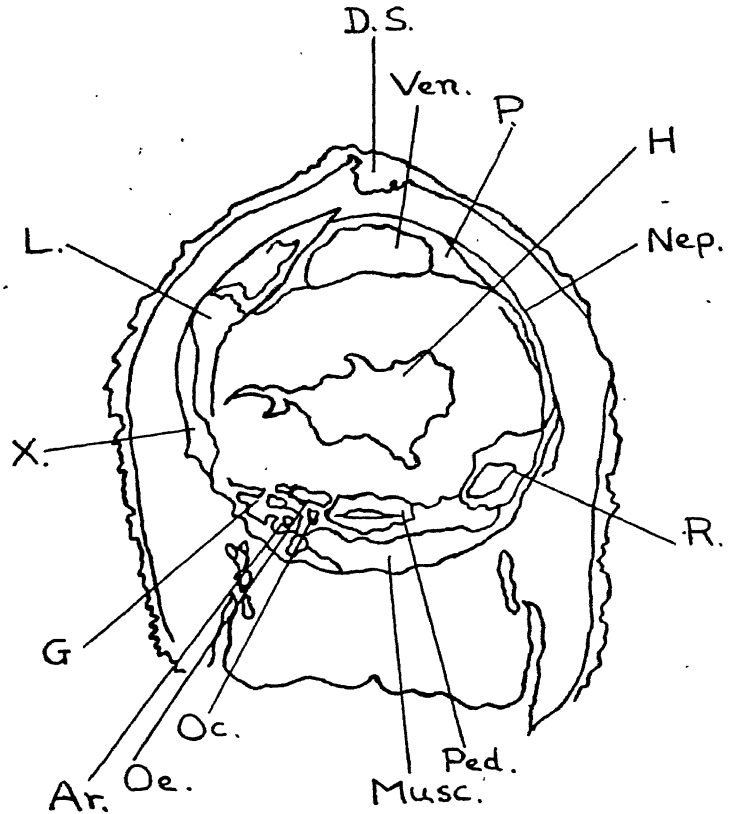
Plate XXXIII. 1. Microphotograph of radula, from preparation by Col. Peile. (Specimen from Kedah).

2. Microphotograph through the anterior tentacle, shewing the structure of the eye.





Atopos sarasini Collinge.



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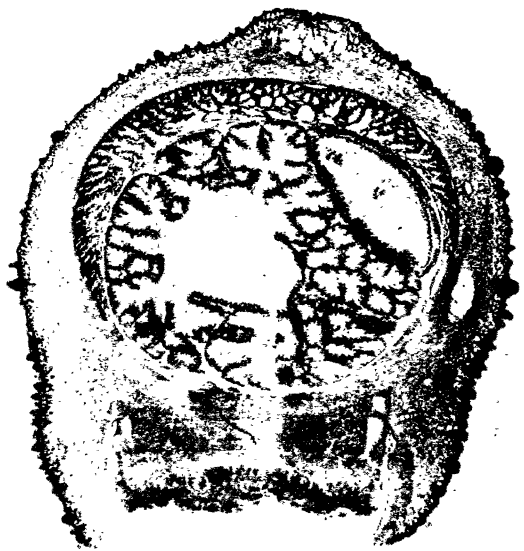

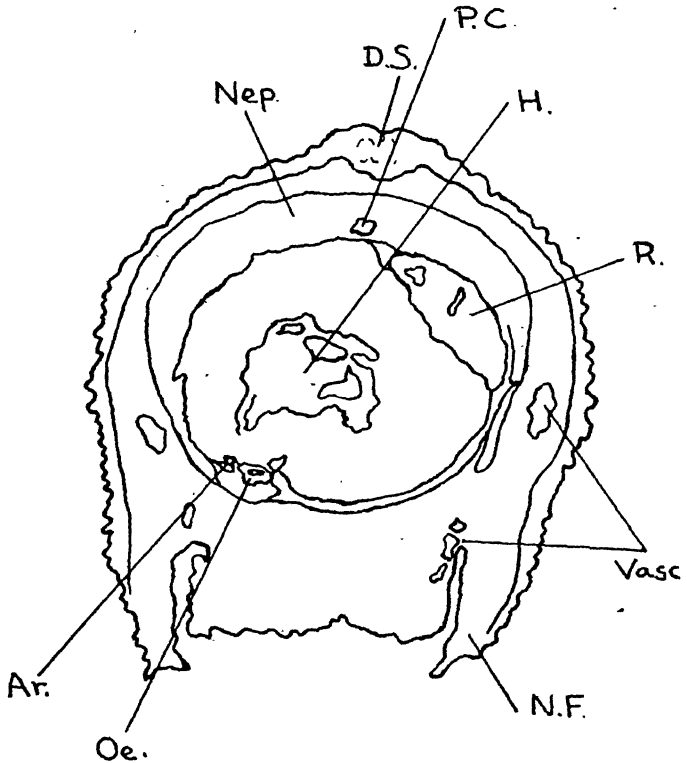

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Atopos sarasini Collinge.

A note on the occurrence of Parafossarulus striatulus (Bens.) in the Malay Peninsula

By F. F. LAIDLAW

Amongst the fresh-water mollusca listed by Ghosh (1929) from the Batu Caves, Selangor, is a species which he identified as *Paludomus baccula* Reeve.

I have had an opportunity of examining the specimens seen by him, and have concluded that they are examples of Benson's species *Paludina (Bithynia) striatula* Bens. 1842. In this conclusion I have the concurrence of Mr. Tomlin The specimens show a close aggrement with typical examples of *striatulus* from Hanoi, with which, thanks to Mr. Tomlin, I have been able to compare them, the only difference being that the Batu specimens do not show the characteristic spiral sculpture found in the Hanoi specimens. However Tomlin tells me (in litt.) "it varies from strongly ribbed to quite smooth".

Walker (1927) also noted "usually the spiral sculpture is conspicuous, but it varies in degree of development and is not infrequently quite absent".

The species has also been noted by Ghosh as occurring in ponds near Kuala Lumpur, Selangor (Ghosh 1929*a*).

The importance of the presence of this species in Malaya is of course due to the fact that it is a carrier of the trematode *Clonorchis sinensis* Cobb., the oriental bile-duct fluke.

In his list from the Batu caves Ghosh also described a small and very abundant snail as *Paludomus baccula* Reeve var. *minuta* var. nov.

I have been able to examine a large number of this form, and have submitted examples to both Mr. Tomlin and Dr. B. Rensch who agree that they must be identified as *Digoniostoma pulchellum* (Bens.).

This species is common in Assam, but according to Annandale does not occur in Burma.

Its appearance in the Selangor caves is therefore somewhat unexpected. It is present there in extreme plenty, both in the light and 'dark' part of the caves. So far as I know it has not been recorded elsewhere in Malaya.

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